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AL 1

NAGPUR UNIVERSITY

POST OF THE DIRECTOR, LAXMINARAYAN INSTITUTE OF TECHNOLOGY

Applications are invited for the post of the **Director, Laxminarayan Institute of Technology, Nagpur (India)**. The Institute is maintained by Nagpur University from the income of the Bequest of the late Rao Bahadur D. Laxminarayan and receives substantial grants from the Government of India. It provides facilities for under-graduate and post-graduate courses and research in Technology with special reference to Chemical Engineering and Oil Technology at present.

Salary: Rs. 2,000 per month (equivalent to approximately £450 per quarter at present rate). In the case of a candidate selected from abroad, the salary will be paid quarterly in advance. A higher salary may be given in the case of a candidate with exceptional qualifications. No Dearness Allowance or War Allowance will be payable. The appointee will be eligible for benefits of the University Provident Fund and leave in accordance with University Rules. The incumbent will contribute 8 per cent of his salary to the Provident Fund, the University contributing 6¼ per cent of the salary.

Qualifications: The candidate must be a technologist of distinction with high academic attainments in Chemical Engineering and experience in industry and administration and must be able to organize teaching of different branches of Chemical Technology and to guide and supervise research. The appointment is open to candidates from outside India. The appointment will, in the first instance, be made on a contract basis for a period of 5 years. Applications must be made on the prescribed form and submitted in a sealed cover so as to reach the Registrar, Nagpur University, by 30th September 1948. Candidates from outside India need not use the form but their applications must furnish the following details, *viz.*—(1) Age. (2) University degrees. (3) Research and other academic qualifications (copies of publications to be enclosed). (4) Professional qualifications. (5) Teaching experience. (6) Experience in industry and administration and (7) Previous and present appointments held with their emoluments.

No Travelling Allowance will be payable in the case of candidates from India coming for interview before the Selection Committee.

U. MISRA

Registrar, Nagpur University.

Current Science

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THE SCIENCE CO-OPERATION OFFICES OF THE UNESCO

WHEN the United Nations Organisation(UNO) started its activities, it created—or took over from the former League of Nations—a number of so-called specialized agencies, which had to deal with certain particular problems of international importance. One of these agencies is the World Health Organisation (WHO), the task of which is an international campaign against diseases, especially infectious diseases, and epidemics. Another specialized agency is the Food and Agricultural Organisation (FAO), set up to deal with the acute food shortage during and after the war. The United Nations Educational, Scientific and Cultural Organisation (UNESCO) is another of these specialized agencies, which took over the heritage of the Institute International de Co-operation Intellectuelle created by the League of Nations. There is no need to explain the activities of UNESCO in this country where interest is focussed on it and there exist such excellent descriptions of its activities as the booklet published by the Department of Information and Broadcasting of the Government of India.† It suffices to say that the activities of UNESCO being manifold, they are dealt with in various sections within the Secretariat, the headquarters of which is in Paris. One of the sections of UNESCO is devoted to exact and natural sciences and its activities are based on the fact that science and its applied forms (agriculture, medicine, technology, etc.) are playing and will increasingly play an intimate part in all human activities.

Scientific research can make human life healthier, easier, safer and more comfortable (although it can make it more horrible as ever before, too). To ensure that science can freely develop its peaceful aims for the benefit of humanity an international collaboration of scientists and scientific institutions is needed. In our times science cannot be effectively studied individually; scientific research is mainly based on teamwork and a general pooling of the results of man's investigation of nature is essential. Scientific collaboration on international lines is not new discovery. In the XVII century the first academies appointed, from their foundations, foreign secre-

taries to take charge of the correspondence with members of the world community of observers in other countries. But the formal organisation of science internationally was begun only in the XIX century when the custom grew up to hold large "international congresses". Later from these periodically held congresses the system of international unions developed permanent bodies to deal with international problems within a limited subject-matter. These unions are to-day united into an International Council of Scientific Unions and represent an effective tool of international scientific collaboration.

During World War II another type of international scientific collaboration developed. Some of the governments composing the present United Nations set up in one another's capitals "Science Co-operation Offices". The crucial importance of scientific knowledge to the conduct of war made it necessary to ensure that the democratic countries pooled their information. Penicillin, Radar and the Atom Bomb are all cases in point. In contrast to the scientific congresses and the International Unions the wartime science co-operation offices were not confined to any one particular science. But they were bilateral or restricted as to national scope. The largest of these offices during World War II were the British Commonwealth Scientific Office in Washington and the United States Scientific Mission in London. But there were many others, such as the French Scientific Missions in London and Montreal, the Australian Scientific Research Liaison Office in London, the Office of the Australian Scientific Counsellor in Moscow, etc. Most of these were mainly concerned with exchange of information concerning war sciences. There was, however, one such office which dealt not only with war sciences, but with scientific matters concerning agriculture, industry, pure and applied sciences for reconstruction, etc., as well. This was the Sino-British Scientific Office in China (Chungking). From the work of this office and similar other activities arose in the minds of a number of persons more or less simultaneously the realisation of the intense value of chain of such offices in peace time.

UNESCO took up this idea with great enthusiasm. Dr. Needham, who was head of the Sino-British Scientific Office in China during the war, developed in his capacity as head of the Natural Sciences Section of UNESCO a scheme of such offices on an international scale for peaceful purposes. But many others have expressed similar ideas. One of the leading scientists of this country, Dr. (Sir) S. S. Bhatnagar, President of the National Institute of Sciences of India, reached exactly the same conclusions in an article of the booklet of the Department of Information and Broadcasting mentioned above ("Science and International Co-operation", page 27 ff.). His idea of "regional scientific co-operation stations" corresponds in all details to the Science Co-operation Offices (sometimes called *Field* Science Co-operation Offices to denote their regional character) of UNESCO. The great value of this type of international scientific co-operation in addition to the activities of the International Unions is obvious. The Unions are not limited by country, but they are limited as to subject-matter. The Offices are not limited by subject-matter but their activities are devoted to that part of the world in which they happen to be. Thus the two systems of international scientific co-operation complete each other in a most fortunate manner.

UNESCO has a formal agreement with the International Council of Scientific Unions by which it will be able to promote their activities (and has already substantially done so, supporting international congresses, paying for their publications, etc.). In 1947 it began to establish a system of science co-operation offices, in various regions. It started with three offices, in Riode Janeiro (for Latin America), in Cairo (for the Middle East) and in Nanking (for the Far East). The fourth office has just recently been opened in this country (as reported in "*Current Science*," May issue, page 169), following the urgent appeal of India's delegates at the last General Conference of UNESCO.

The Office is provisionally lodged in the Science Buildings of the University of Delhi, the authorities of which have shown a really cordial spirit of help and understanding. This gesture is most encouraging for the future activities of the Office which will depend to a great extent on the support and readiness to co-operate of the scientists and scientific institutions of this country. The question of finding definite lodgings and the possibility of establishing some branch-offices in great scientific centres of South Asia are still under consideration.

Finally, a few words may be said about the proposed activities of the Science Co-operation Office of UNESCO in this country and other parts of South Asia. One of the first aims is

to establish and maintain personal contacts and cordial relations with government departments concerned with science and with scientific societies, university faculties, research institutions and associations as well as with individual scientists and technologists of the countries of the region. Furthermore, the Office wishes to act as a clearing house and information centre for the supply and distribution of scientific literature, essential scientific equipment and material, ensuring that they reach the proper recipients. Even unpublished data and raw ideas and suggestions should be supplied and distributed whenever possible. The office wishes to assist with all problems of scientific documentation, *e.g.*, translations, abstracts, microfilms, reprints, etc. It wishes to facilitate the outward flow of scientific and technical reports from laboratories and other sources as well as scientific journals. From time to time the Office will inform the scientific world about interesting work being carried out in the subcontinent. A further aim is to arrange the exchange of scientific correspondence and manuscripts, scientific papers, articles and reviews for publication. A scientist once said, "A scientific post office requires the qualities of a 'department of insufficient addresses' for its aim should be to ensure that every communication reaches its proper destination, a destination which the author himself may only vaguely know." The Science Co-operation Office of UNESCO wishes to be such a post office too. It will also assist in the exchange of persons by making suggestions for travel grants to UNESCO or to the International Unions, as far as such grants are available. Of course, the Office will collaborate with bilateral scientific missions and scientific attaches within the region and will co-operate with and advise when possible other specialized agencies of the United Nations, such as FAO, or WHO. The Office will also assist, whenever possible, in the exploration of the possibilities of the foundation of international scientific laboratories and observatories in the region. (For South Asia, at the moment, projects of an International Institute of Fisheries on the shores of the Indian Ocean, the internationalization of some of the Indonesian research institutions and as a later scheme the establishment of an International High Altitude Research Institute on the slopes of the Himalayas are under consideration.) Assistance will be given in the study of the feasibility of international stock-rooms, *e.g.*, pure chemicals, new materials, radioactive isotopes, type-cultures, pure line strains of laboratory elements and of plants, etc. Finally, an important aim is to assist in the compilation of a world register of scientific institutions and scientists.

There are several means by which these aims and tasks may be realized. But the most important of them is the active help and willingness to co-operate of all the scientists and scientific institutions mentioned above. If this will be granted, the UNESCO's Science Co-operation Offices will be able to do their share in bringing scientists of the world closer together, and by this aiding the maintenance of peace and improvements of living conditions of the peoples of the world.

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†"*UNESCO*" Modern India Series, I, 1946.

INDIAN JOURNAL OF DAIRY SCIENCE

WE have received a copy of the two numbers (March and June) of the *Indian Journal of Dairy Science*, the official organ of the Indian Dairy Science Association. This quarterly according to the Editor, is "the outcome of a long-felt desire on the part of all persons concerned with Dairy Science in India to find a satisfactory medium of expression to cover the large and growing developments in the science and practice of dairying in this country and to serve as a link between scientific workers engaged in different parts of the world."

The issue contains six original contributions on various aspects of Dairy Research, *viz.*, Studies on Cotton Seed Feeding to Milch Animals, Composition of Milk Fat of Various Species of Animals, Phosphatases in Milk, Comparative Study of the Ten Minutes' Resazurin Test, Storage of Indigenous Butter and Studies on Vagetable Rennets. Some of the articles, however, do not appear to have received the same degree of editorial scrutiny as the rest.

The get-up of the Journal, considering the present conditions of printing in this country, should be regarded as excellent. We wish the Journal an eventful and uninterrupted career in the service of the pure and applied aspects of Dairy Science.

ORGANISATION AND WORK OF THE CAVENDISH LABORATORY*

SIR LAWRENCE BRAGG, O.B.E., F.R.S.

THE Cavendish Laboratory is faced with problems which are common to most scientific laboratories in this post-war period, and arise from the great expansion in the numbers of undergraduate and graduate students. Part of this increase is a temporary phenomenon. Men are being released from the Forces who have missed the whole or part of their undergraduate time at the university, and are returning to swell the classes. The increase in the first- and second-year students at Cambridge is perhaps not as great as it is in other universities, because the undergraduate population is limited by college accommodation; in physics these classes at present are some 50 per cent. greater than they were before the War. The numbers in the final honours class, however, have almost trebled, because men returning from war-work for the most part join this class, which now has about a hundred and twenty students. It will probably remain considerably higher than its pre-war level, because the recommendations of the Barlow Report reflect the need of the nation for more scientists, and demand is creating a supply. The greatest increase of all is in the number of research students, and here the Laboratory is crowded to capacity, if not overcrowded. Although all available places are used, the number of those who apply for admission as research students is three or four times as great as the number which can be accepted each year. More than a hundred and sixty researchers are now working in the Laboratory, of whom 110 are research students working for their Ph.D. degrees—between one-fifth and one-sixth of the total number registered for research degrees in Cambridge.

This large increase implies a major change in the organisation of the Laboratory. The old days when the head of the department could be in close contact with all his research students are a matter of the past. There would appear to be a limit in organisations of all kinds to the number of men whom any one head can direct by close personal contact, this number being about six. It applies in the direction of research as well, and devolving of responsibility is essential when numbers rise above this limit. Even before the War, numbers of researchers in the larger laboratories were approaching the 6^2 level, and now they are in the 6^3 region. In other words, the organisation of the research work involves splitting up the men into large groups under leaders, and these again into smaller groups, so that the head of the department is two removes from the researcher himself. Except in a few special cases of work in which he is particularly interested, he cannot afford to spend that two or three-hour period every fortnight or so talking over his work with the individual, which is essential for real direction.

The major groups in the Cavendish Laboratory are nuclear, radio and low-temperature physics, crystallography, metal physics and mathematical physics, with some minor groupings. It may be interesting to give some account of the extent to which these groups are independent, and of the common ground on which they meet. The great foe of research is administrative responsibility. A nice adjustment has to be made between giving the heads of groups as much freedom as possible to make their plans for using their facilities to the best advantage, and at the same time relieving them of the more tiresome and mechanical details of administration which can be properly centralized. In our organisation each group has its own allocation of the budget for the year, and its own order-book, so that apparatus and supplies can be bought within that budget; each has its own staff of assistants and its workshop; it has its own secretary for clerical work; further, each group runs its own colloquium, where scientific papers from other laboratories are discussed and the researchers give reports of their progress. The days are past when most researches in a department were on closely related lines and a joint colloquium was possible. A colloquium in one group or another is now an almost daily event, and no individual can spare the time to go to them all. Common touch is kept up by the fortnightly meetings of the Cavendish Physical Society, where the heads of the groups give an account of the work going on in their sections, and distinguished visitors speak, and by more informal meetings of the leading researchers, such as the little club which was founded by Kapitza when he was head of the Mond Laboratory.

The administrative burden of the teaching staff has been much lightened by the appointment by the University of a secretary to the Laboratory. This officer has in his charge finance, appointments of assistant staff and rates of pay, the formal work concerned with admissions, structural alterations and upkeep of the buildings, preparation of agenda for meetings, and other matters of this kind.

A main workshop serves all sections of the Laboratory, where work requiring special tools and skills is carried out; glass-blowing is also centralized. There is also a separate central workshop where research students can use the machine tools, where the young assistants are trained, and where repairs to class-apparatus are carried out. In addition, two special centres deserve mention. It has been found convenient to have a 'special techniques' workshop where the most highly skilled and delicate work of especial kinds is carried out, and to place this workshop in charge of a member of the staff. It is largely concerned with the construction and sealing of Geiger counters, and the purification of the gases with which they are filled. Special thermionic devices are made there, and evacuated, baked and sealed. It manufactures delicate metal parts by a photographic technique, such

* From a course of three lectures at the Royal Institution on March 4, 11 and 18.

as supports for thin-walled windows, makes special metal-to-glass or metal-to-silica joints, and has apparatus for preparing thin metal films by evaporation. The other centre, also in charge of a member of the staff, constructs and maintains electronic equipment of all kinds, such as decimal scalers and multiple coincidence circuits, or pulse and D.C. amplifiers for nuclear work. The capital value of the electronic equipment of this kind approaches five figures, and it is a saving of time and money to place it in charge of an expert.

The largest group in the laboratory is the nuclear physics group, under Prof. O. R. Frisch and Mr. E. S. Shire, with some forty researchers. The Cambridge equipment includes the one-million and two-million volt sets in the high tension laboratory, and a cyclotron with 37-in. pole-pieces. A five million volt Van de Graaff generator is being built for the Laboratory by the English Electric Company, and it is hoped to get it running by the end of 1948. The maintenance of this large and complex units introduces problems of a new scale in a physics laboratory. It creates the need for a new type of staff member, the 'Technical Officer'. He must be a trained physicist, in general a University Graduate, but a man who has the engineer's outlook and who is interested in the construction and functioning of the apparatus rather than in the research which is done with it.

The radio group represents the continuation in the Laboratory of the work which Sir Edward Appleton started when he occupied the Jacksonian Chair at Cambridge; it is now under the direction of Mr. J. A. Ratcliffe. It has field stations as well as its section of the main Laboratory. The work on propagation is mainly concerned with the longer wavelengths which are reflected below the *E*-layer. Another section is making measurements of the waves in the metre wave-length region coming from the sun, recording their intensity and propagation and estimating the size of the source from which they come by a method analogous to Michelson's method of measuring the angular diameter of a star.

The Mond Laboratory is now under the direction of Dr. D. Shoenberg, its former head, Dr. J. F. Allen having been recently appointed to St. Andrews. A main interest is the properties of superconductors, in particular the penetration of magnetic fields into superconductors. It has equipment for the magnetic method of cooling. Liquid helium is at present made by Kapitza's expansion machine; but a new machine of greater capacity and more orthodox type is under construction.

In crystallography, under Dr. W. H. Taylor, the arrangement of atoms in minerals, alloys, organic compounds and proteins is being studied. The section studying proteins under Dr. M. F. Perutz and J. C. Kendrew has this year been accorded the backing of the Medical Research Council. The elucidation of the structure of such enormous and complex molecules is the most ambitious problem as yet tackled by X-ray analysis, and success would cast a flood of light on the structure of living matter.

The metal physics section, under Dr. E. Orowan, is concerned with problems of slip and plasticity, fracture, crystal growth, and metallic phenomena in general investigated by physical methods.

The Laboratory houses an electron microscope service which is used by all departments of the University. It provides hospitality for several researchers from other departments. Particularly welcome guests are the mathematical physicists, including the Plummer Professor, D. R. Hartree, who have rooms in the Laboratory.

It may be of interest to assess in round figures the cost of research in the Cavendish Laboratory. The figures must be approximate, since many of the services are common to teaching and research. As an example, in the following estimate the time of the University staff is regarded as divided equally between teaching and research, and its cost apportioned accordingly. Making similar adjustments for administration, assistant staff, stores and apparatus (almost entirely research) and so forth, the total expenditure on research in the Laboratory (including the Mond) was just short of £ 60,000 in 1946-47, of which £ 10,000 came from outside sources. To this must be added a sum to represent the rental of the buildings, which does not appear in the estimates. In estimating the cost per research student, the abnormal position of nuclear research must be taken into account. Not only are the running expenses above the average, but also units such as the cyclotron represent a large outlay of capital, and special grants are made by the Department of Scientific and Industrial Research to meet needs which the University cannot finance from its own resources. Such requirements vary very greatly from year to year, and I have therefore only included a sum for nuclear research which corresponds to the expenditure per researcher in other branches of physics, and which roughly represents the contribution which the University itself makes towards the cost of the nuclear research. On this basis, the cost per research student is £ 400 a year. If to this is added £ 350 to represent the average maintenance grant of junior and senior workers, the total cost to the state of maintaining a research worker in the Cavendish Laboratory is £ 750 a year.

EXCHANGE OF SCIENTIFIC KNOWLEDGE—AUSTRALIA AND INDIA

THE Australian Goodwill Scientific Mission which visited has recommended that a party of Indian scientists be invited to visit Australia.

At a later date, when conditions are more normal, it is expected that students from there may be afforded facilities to carry out post-graduate work in Australia, and that an exchange of workers between the Council for Scientific and Industrial Research in Australia and the Council for Scientific and Industrial Research of India may be arranged.

In the course of a report which the Australian mission has issued, it is stated that all Indian universities evince "considerable interest in Australian universities and student life. Members of the delegation are stated to have received a large number of enquiries from Indian students about the possibility of undertaking work, particularly post-graduate study, in Australian universities. The report adds that many Indians are thinking of Australia as a place for post-graduate training in addition to Europe and America.

"The various difficulties Australian universities would experience at present in accommodating Indian students, due to over-crowded post-war conditions, were explained to the enquirers. Nevertheless, it is apparent that a demand is likely to arise from Indians to study in Australia, and the delegation feels that when conditions become more normal this should be encouraged.

"It is also possible that there are certain scientist in India, for example, Sir C. V. Raman at the Indian Institute of Science, and Professor P. C. Mahalanobis, the Director of the Institute of Statistics at Calcutta, under whom Australians might wish to study.

"The exchange of students at an impressionable age would be very useful in building up goodwill between the two countries", the report continued. "Members of Indian University staffs also enquired about the possibility of visiting Australia for short periods for lecturing or research purposes and about the possibility of arranging exchanges. The detailed method of carrying out such suggestions would involve many difficulties, but it is felt that everything should be done to encourage exchange wherever possible. There is no doubt that in the academic world India looking to Australia as a friend."

SCIENTISTS ARE BORN AND NOT MADE

CAPACITY for creative thinking is a relatively rare inborn talent. Under proper environmental stimulation, it develops that quality of mind essential in original research. Advances in science will depend upon discovering this talent and putting it to work. The need for doing this is well recognised to be in the national interest and is giving rise to the appropriation of vast federal funds for research and legislation toward the establishment of a National Science Foundation. These measures, valuable as they can be in encouraging the development of scientific ability, cannot create scientists. From the overcrowded graduate schools come hundreds each year with the doctorate in chemistry and other sciences. Yet the great majority of these young Ph. D.'s have no real ability in original thinking! Learned, proficient, and skilled they may be in experimental techniques, but these are not substitutes for intelligence and the capacity to have ideas.

It is evident that the first and most important step toward increasing the yield of men qualified for research is to seek out and recognise the essential talent when it appears. Graduate school need to become more discriminating in their acceptance of candidates for the doctoral degree and more courageous in rejecting those lacking the qualification. Too often the persistent attain what only the giftted deserve. By the assignment of problems requiring the exercise of research talent early in the first year of graduate work, it should be possible to discern latent ability if it exists. Those who display definite evidence of research capacity should then be admitted to what might be called the "higher" graduate school and go on for the doctorate. The present emphasis in graduate training on course work and doctoral thesis often fails to allow sufficient opportunity for training in and practice of research methods. As a consequence, men enter research careers lacking familiarity with the research approach to problems.

It is not more graduate school capacity that is needed today but better selection of those who are to be trained. Men possessing capacity for creative thinking deserve the full attention of graduate faculties and school facilities. Society will be the beneficiary when this comes about.

(By courtesy of The Journal of the Electrochemical Society, 93, 53N, 1948.)

PROCUREMENT OF RADIOACTIVE ISOTOPES

IT has been decided that all matters connected with the procurement of radioactive isotopes are to be handled in India by the Board of Research on Atomic Energy in consultation with the Department of Scientific Research. Requests for the procurement from abroad of radioactive isotopes or any information relating to Atomic Energy should therefore be addressed to the Department of Scientific Research who will forward them after scrutiny through the appropriate channels. Requests addressed directly to foreign governments or their representatives in India are not likely to be acted upon.

LETTERS TO THE EDITOR

A CHALLENGE TO MATHEMATICIANS

Here is a problem which I wish to offer as a challenge to mathematicians, especially those who deem themselves so superior that they will not touch anything in elementary mathematics even with a broken rod. But the great mathematical philosopher, A. N. Whitehead, has said that elementary mathematics is one of the most characteristic creations of modern thought by virtue of the intimate way in which it correlates theory and practice. I now come to my problem for which I require a strictly *non-visual proof*, a proof which should make the least appeal to intuitive relations perceived by the physical eye.

Problem: Two intersecting straight lines (or planes) and a point not incident on either of them are taken in a plane (or space). Show that the line joining the feet of the perpendiculars from the point to the straight lines (or planes) subtends at the given point an angle which is always the supplement of that angle between the two straight lines (or planes) in which the given point lies.

If a figure is drawn or a model is prepared, the property becomes visually evident but real mathematics does not and should not seek the help of the eyes of the body but the eye of the mind. An algebraic identity is not true because you can write it down and see it.

Will mathematicians take interest in the above little problem which is very useful in settling angular ambiguities which teachers glibly pass over in their routine teaching?

Mysore, A. A. K.
July 30, 1948.

EFFECT OF INCREASING FREQUENCIES ON THE ULTRASONIC DIFFRACTION PATTERNS

David,[1] basing himself on Brillouin's work, has developed a theory which leads to the following expression for $I_{\pm}$, the intensity of the +1 or −1 order diffraction line in the case of normal incidence.

$$I_{\pm} = I_m \left[\frac{\sin \frac{n\lambda L}{2\mu_0 \lambda^{*2}}}{\frac{n\lambda L}{2\mu_0 \lambda^{*2}}} \right]^2$$

λ is the wavelength in vacuum of light that is being diffracted, λ^* is the wavelength of sound or the grating element in the liquid, μ_0 is its refractive index and L is the length of the sound field. I_m stands for the maximum intensity of this line, which occurs when the obliquity of the sound wave front is such that the diffracted ray is emerging in a direction which corresponds exactly to that of Bragg reflection. This condition is attained for the first order lines when the tilt angle θ is $\sin^{-1} \lambda/2\mu_0\lambda^*$. It is easily seen from the above ex-

pression that for a given λ, L and μ_0; increasing sound frequency which means a decreasing value of λ^* will result in a rapidly diminishing value for I $\pm$ because the numerator within the brackets never exceeds unity while the denominator, containing λ^* in its fourth power, goes on increasing. Thus the angular range in which the diffraction lines persist goes on diminishing, the lines themselves being steadily weakened in the normal incidence position until they disappear altogether for the first time when λ^* is such that the relation $\lambda L/2\mu_0\lambda^{*2} = 1$ is satisfied. This is an important result. A revival of intensity for still lower values of λ^* is indicated but this will be so small that lines, if they reappear, will be of very feeble intensity. They will again disappear when $\lambda L/2\mu_0\lambda^{*2} = 2$ and thereafter it should be extremely difficult to observe the patterns at all

The same result may be obtained in a different manner. Raman and Nagendra Nath,[2] starting from very simple considerations, concluded that the diffraction effects will periodically disappear, as the obliquity θ of the sound wave front from the position of normal incidence takes values successively equal to $\tan^{-1} n\lambda^*/L$ with $n = \pm 1, \pm 2, \pm 3$ and so on, $n \neq 0$ being excluded. This is due to the fact that a plane light wave front entering the liquid under such conditions emerges without any corrugations in it. It is obvious that such a destructive effect will take its full toll of the diffraction pattern if it occurs for the first time at an obliquity which is the same as would otherwise have given rise to a maximum intensity for the first order diffraction line. In other words, if λ^* has become low enough to satisfy the condition $\tan^{-1}\lambda^*/L = \sin^{-1}\lambda/2\mu_0\lambda^*$, there will appear no diffraction spectra even in favoured positions, not to speak of normal incidence. If we are dealing with small angles the above condition reduces to $\lambda L/2\mu_0\lambda^{*2} = 1$, In practice, however, there may be small. remnant intensities in narrow angular ranges roundabout the appropriate obliquities. As in the previous case, a feeble revival of intensity is indicated for still smaller values of λ^*, but conditions favourable for total destructive interference again occur when $2\lambda^*/L = \lambda/2\mu_0\lambda^*$ which is the same $\lambda L/2\mu_0\lambda^{*2} = 2$. Thereafter it should be extremely difficult to observe the patterns at all.

For $\lambda = 5400 \times 10^{-8}$cm.; L = 8 mm.; $\mu_0 = 1{\cdot}333$; λ^* satisfying the above conditions comes out as 0·004 cm. and 0·0028 cm. corresponding to frequencies of 37 and 53 Mcs/sec. in water. Experiments, specially designed to cover the high frequency regions, have yielded results which are in agreement with the above conclusions. At 50 Mcs./sec., the first order diffraction lines in water could be recorded faintly in normal incidence. In that position, they are not obtained at all, if sound frequencies in the range 100 to 200 Mcs./sec. are used.[3]

Andhra University, S. BHAGAVANTAM.
Waltair, *July* 27, 1948.

1. *Physikal. Z.*, 1937, **38**, 587. 2. *Proc. Ind. Acad. Sci.*, 1935, **2**, 413. 3. *Nature*, 1918, **161**, 927.

THE ELECTROLYTIC PREPARATION OF ROCCELIN

THE electrolytic preparation of azo-dyes was first carried out by Löb.[1] Löb claimed to have prepared, by electrolysing molar proportions of an amine, a suitable coupling component, usually a phenol, and sodium nitrite in a neutral or alkaline medium at a platinum anode with vigorous stirring, the dyes Roccelin, Orange II, Congo red, Chrysamine G and Di-anisidine blue. Löb does not give experimental details or yields or describe the quality of the dyes prepared by this method. Brockman and Griffin[2] confirm Löb's results so far as the dyes Roccelin and Orange II are concerned but report that they were unable to prepare Congo red and Chrysamine G as claimed by Löb. Brockman and Griffin state the yield of the dye Roccelin to have been quantitative with over 95% current efficiency.

This claim is open to doubt, in view of the mechanism proposed for the reaction. Löb, who discovered the reaction, suggested that it took the following course:

$$NO_2^- \rightarrow NO_2 + e$$
$$R.NH_2 + NO_2^- \rightarrow R.N_2.OH + OH^-$$

The diazo-compound would then couple in the usual way with the phenol or other coupling component to give the dye.

Glasstone, in a review[3], proposes a somewhat different course:

$$NO_2^- + H_2O \rightleftharpoons HNO_2 + OH^- \quad (1)$$
and $$2\,NO_2 + H_2O \rightarrow 2HNO_2 + \tfrac{1}{2}O_2 \quad (2)$$
followed by $$R.NH_2 + HNO_2 \rightarrow R.N_2.OH + H_2O \quad (3)$$

Though this is not stated by Glasstone, Eq. 2 evidently involves the action of discharged nitrite ions. It will be seen that in either scheme of reaction the discharge of nitrite ions is a necessary step in the formation of the diazo-compound. However, the reaction can be carried out only in a neutral or alkaline medium, for obvious reasons. The reaction represented by Eq. 1 in Glasstone's scheme would be shifted to the left in an alkaline solution, and at the same time, hydroxyl ion discharge is likely to predominate over nitrite ion discharge at the anode, on account of the very high mobility of the hydroxyl ion and its lower discharge potential. The first stage of the reaction, that is the diazotisation of the amine, can therefore never take place with 100% current efficiency in any event. Apart from this, the second stage, namely the coupling of the diazo-compound with the coupling component depends both on the rate of diazotisation of the amine and on the alkalinity of the reaction medium.[4] When a naphthol is the coupling component, the medium is generally kept alkaline though not excessively so. Brockman and Griffin have carried out the electrolysis in neutral solution which means that in the course of electrolysis the vicinity of the anode would have become distinctly acid, so that the coupling reaction would be slowed down. The result would be a drop in the current efficiency, and the yield of dye would be far less than that claimed by Brockman and Griffin.

It was therefore decided to reinvestigate the problem with special attention to the role of nitrite ion discharge in the reaction. This investigation, apart from testing the validity of the claims of the earlier authors, has the additional advantage of introducing a very convenient method of producing azo-dyes, which it would be worthwhile to place on a practical basis. No special precautions need be taken such as are observed with the current methods of preparing these dyes involving cooling baths and so on. The formation of the dye Roccelin was taken up for study first.

Experimental

I. Brockman and Griffin's Method

In order to verify the results claimed by Brockman and Griffin (*loc. cit.*) several runs were carried out reproducing the conditions described by these authors except that the dimensions and quantities were exactly halved. The cell consisted of a 400 c.c. Pyrex beaker inside which a polished platinum foil anode of effective area surface of 20 sq. cm. fitted snugly. A nickel rod formed the cathode and it was positioned inside a dense type alundum cup which contained the catholyte. A motor driven glass stirrer served to agitate the anolyte.

A typical run was as follows:

3·06 gm. Sodium naphthionate,
1·80 gm. β-Naphthol,
and 0·87 gm. Sodium nitrite

were taken in 150 c.c. of water in the anode compartment. The catholyte was a 5% solution of sodium hydroxide. A current of 0·5 amp. corresponding to a current density of 2·5 amps./dm.^{2} was passed for 40 minutes, with vigorous stirring, since the theoretical requirement of current was 20 ampere-minutes. The temperature of the anolyte was 30° C. The anolyte developed a deep red colour during the electrolysis. The dye is soluble in water and was recovered from the anolyte by salting out carefully. Sodium chloride was added in small portions with good stirring till a drop of the liquid placed on filter-paper had a colourless rim. The precipitated dye was filtered at the pump, washed with dilute sodium chloride solution, dried in the air-oven at 80° C. for two hours and then in a vacuum desiccator overnight. It was then weighed. The yield of dye, which had a dark red colour, amounted to 1·15 gm. or 23% of the theoretical. This is a far lower yield than that claimed by Brockman and Griffin under the same conditions (80%).

This difference is too large to be due to experimental error. Every precaution was taken to reproduce exactly the conditions described by these authors except that the dimensions of the cell and the quantity of the components were halved. The discrepancy continued to be puzzling until it was discovered that the sodium naphthionate and β-naphthol left unreacted at the end of the run were also salted out along with the dye, if too much salt was added to the anolyte for the purpose of salting out. Naturally the product then weighed 4·6 gm. and was indistinguishable from the dye itself in colour and appearance.

II. The Influence of Anions

The results obtained above during the preliminary study clearly indicate the importance of nitrite ion discharge in the formation of the dye. Factors that interfere with the formation of free or discharged nitrite ions will therefore most likely affect the dye yields. One way of testing the validity of this conjecture would be by adding anions of different mobilities and observing if there is a corresponding change in the yield. Several runs were therefore made as already described, 1/40 Mol each of sodium chloride, sodium nitrate, sodium sulphate or sodium hydroxide being included as the addition agent. The dye yields showed a distinct dependence on the mobility of the added anion, as can be seen from the results recorded in Table I.

Table I

Effect of added anion on the yield of dye
Temperature: 30° C. Current Density: 2·5 amps./dm.^{2}

Anion added	Ionic Mobility	Yield of Roccelin
OH' ..	192	nil
..	..	23·0%
$\frac{1}{2}SO_4''$ ..	79·0	14·8%
Cl' ..	75·5	16·2%
NO_3' ..	70·6	22·6%

It will be noticed that when hydroxyl ion is the added anion, the yield of dye is zero. The anolyte, during this run, developed a faint red colour only after the current had been passed for a time much longer than that theoretically required. This is probably because the highly mobile hydroxyl ion gets discharged preferentially, nitrite ions coming into the picture only at a later stage.

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April 21, 1948.

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AN EXPLANATION OF THE INHIBITIVE INFLUENCE OF THE APPLIED POTENTIAL ON *JOSHI-EFFECT* AND ITS ENHANCEMENT IN H.F. COMPONENT OF THE DISCHARGE CURRENT

Studies of the *Joshi-Effect* Δi [1,2,3], an (almost) instantaneous and reversible photo-diminution of the conductivity i due to a given applied potential kV, in various gases and vapours excited in a Siemens' type (glass) ozoniser, have revealed that, in general, the magnitude of $\%\Delta i = 100\Delta i/i_{dark}$ is maximum near 'threshold potential' V_m, at which the system breaks down as a dielectric and Δi occurs; and thereafter it decreases progressively as kV is increased.[3,4,5,6] Furthermore, the H. F. component (i_{HF}) of i which is a vectorial sum of various

frequency currents,[5,7,8,9] is the chief seat of Δi.[6,8,10] In the present note an attempt is made to explain these general findings.

A Siemens' ozoniser is a system of three serial capacities: C_1 and C_2 are associated with the outer and inner tubes of the ozoniser and C_g represents the capacity of the annular space filled with the excited gas or vapour. At and above V_m, the capacity C_g may be treated as a combination of a capacity C_g shunted with an ohmic resistance R_g which represents the inverse of the conduction current produced in the gas due to ionisation by collision under the applied field.[11]

The electrical circuit which is generally adopted to study the *Joshi-Effect*, is shown in Fig. 1 (*a*). Fig. 1 (*b*) shows the ozoniser circuit. Let C be the resultant capacity of C_1, C_2 and C_g; and R_s and C_s [Fig. 1 (C)] in series

FIG. 1 (a)

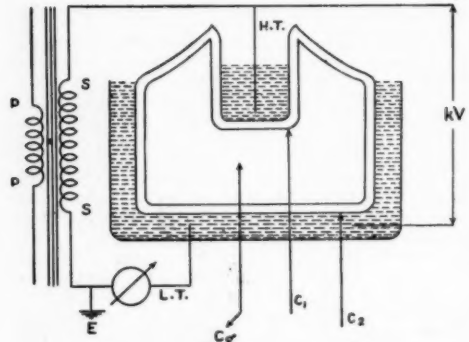


FIG. 1 (b)

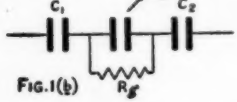
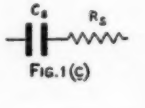


FIG. 1 (c)



be equivalent to R_g and C in parallel. By equality of *impedances*,

$$\sqrt{R_s^2+1/\omega^2C_s^2} = 1/\sqrt{\frac{1}{R_g^2}+\omega^2C^2} = R_g/\sqrt{1+\omega C^2R_g^2} \quad .. \quad (1)$$

By equality of *phase angles*,

$$1/\omega C_sR_s = \omega CR_g \quad .. \quad (2)$$

$$\therefore R_g/\sqrt{1+\omega^2C^2R_g^2} = \sqrt{R_s^2+1/\omega^2C_s^2}$$

$$= R_s\sqrt{1+1/\omega^2C_s^2R_s^2} = R_s\sqrt{1+\omega^2C^2R_g^2}$$

$$\therefore R_s = R_g/(1+\omega^2C^2R_g^2) \quad (3)$$

and also, from (2), $C_s = 1/\omega^2 CR_gR_s$

substituting the value of R_s in terms of R_g and C,

$$C_s = (1+\omega^2C^2R_g^2)/\omega^2CR_g^2 = C\,(1+1/\omega^2C^2R_g^2) \quad .. \quad (4)$$

From (3), $R_s = 1/(1/R_g + \omega^2C^2R_g) = 1/(1/R_g + 4\pi^2f^2C^2R_g)$

The ohmic resistance R_g is sufficiently large. Thus to a good approximation,

$$R_s = 1/4\pi^2 f^2C^2R_g \quad .. \quad (5)$$

and C_s is very nearly equal to C.

As the applied kV is increased above V_m, ionisation by collision increases; and therefore, R_g and C (because C_g decreases) decrease. It is therefore, evident from (5) that at a constant frequency f, the series resistance R_s increases progressively on increasing the applied kV. Since an increase in the circuit resistance is accompanied with a corresponding marked decrease in $\%\Delta i$[5,12], it is easily shown that at large kV, $\%\Delta i$ would be low. This is in good accord with numerous results[3,4,5,6] established in these Laboratories.

Oscillographic studies of the phenomenon have shown that as soon as light falls on the discharge tube, the amplitudes of various components of i, are suppressed to different degrees.[7,8,12] Furthermore, the larger the suppression the greater is $\%\Delta i$. It is a well known fact that the ohmic resistance damps electrical oscillations. Furthermore, the greater the value of the resistance, the larger is this damping. At a given kV, R_g is (fairly) constant. Since $R_s \alpha 1/f^2$ [*vide*, equation (5)] it would be low for H.F. component as compared to its value for other components, *viz.*, i_{LF} and i_s the supply component and its harmonics. Thus it is seen that prior to irradiation the damping is less in i_{HF} than in i_{LF} and i_s. On the assumption that larger the amplitude of the current greater is suppression due to light, it is anticipated that $\%\Delta i$ should be in the order $i_{HF} > i_{LF} > i_s$. This is fully in conformity with results observed in various systems.[6,8,10,13]

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June 6, 1948.

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A NOTE ON THE PROPERTIES OF PLASTER OF PARIS PREPARED FROM SEA-WATER GYPSUM

SEA-WATER contains 3·7% of total solids of which 1·36% is $CaSO_4$. The range of maximum insolubility in brine is between 15° Be and 25° Be and in consequence gypsum separates in the secondary condensers as a thin crust on the clay bed of the condensers on salterns. The deposit is usually in the form of lenticular, fibrous crystals of not more than 1/4 inch mesh closely packed together in a solid gypsum cement. The crude gypsum is obtained by washing off the adhering clay with the sea-water.

The plasters prepared from this crude gypsum under different conditions are compared with the mineral gypsum plasters. Further experiments are in progress with a view to improve the quality of the product and to examine the possibility of commercial exploitation. The

crude gypsum was freed or nearly freed from the chloride by levigation and the centrifuged product was converted to the plaster by roasting in open kettle and the compression strengths of the different samples carried out in duplicate compared. The plaster was sifted through 90 mesh and ratio of plaster to water was 100 : 60. In all cases the strengths were measured with material sifted through 90 mesh after obtaining constant weight, which usually took seven days.

TABLE I

	Compression str. lbs./sq."
(1) Gypsum, washed and roasted:	
(a) fraction over 20 mesh crushed and sifted	2010
(b) fraction below 20 mesh crushed and sifted	1250
(c) crushed and sifted	1500
(2) Gypsum, crushed and washed	
(a) fraction over 20 mesh roasted and crushed	1850
(b) below 20 mesh roasted and crushed	930
(c) roasted and crushed	1310

TABLE II

Comparison of English Plaster (Burrells) with Local Plaster.

	Days	Comp. Str. lbs./sq."	Days	Comp. str. lbs./sq."
Burrell ..	7	1575	14	1680
Local ..	7	1275	14	1600

TABLE III

Rate of deterioration in loosely covered tins in wet weather

	Days	Setting time	Comp. str. lbs./sq."
Burrell ..	14	3–4 minutes	1725
Local 1(a) ..	27	4 minutes	975
1(b) ..	14	5–6 minutes	880
Average with other samples			800–900

The analysis of a sample gave the following results:--

	Present %	Theory %
Water ..	6·58	6·21
(SO_4) as $CaSO_4$ ..	88·90	93·80

The specific gravity of the sea-water gypsum and plaster were found to be 2·25 and 2·62 respectively as compared with figures for mineral product being 2·30–2·33 and 2·57 respectively. Taking Eckel's figures of analysis of mineral plaster it is seen that the purities of the two compare favourably as indicated below:

	$+Al_2O_3 + MgCO_3$ $SiO_2+Fe_2O_3+CaCO_3$	$CaSO_4$	H_2O
Mineral plaster	4·26%	89·42%	6·8%
Sea-water plaster	4·50%	88·90%	6·6%

CONCLUSION

The foregoing results indicate the possibility of getting a good quality plaster from the sea-water gypsum obtained as a by-product at little cost during salt manufacture. It is seen that the plaster from this source compares favourably in many respects to the mineral plaster, though the lower maximum strength, slower rate of hardening and higher rate of deterioration under humid condition militate against its use in dental work. The ultimate strength seems to depend on the original size of particles of gypsum and not on chemical composition. The results in Table I show that the strength depends to a large extent on particle size and that the sequence in the operations add to the effect as a result of variations in the impurities present. Further experiments are in progress with a view to throw greater light into the variations in properties of different plasters and to find out if the sea water gypsum plaster cannot be made to approach the mineral plaster in its properties by economical methods.

Salt Department,
Ceylon, N. G. BAPTIST.
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ANÆMIA IN CHICKS INFECTED WITH *P. GALLINACEUM*

THE significance of anæmia in malaria has been emphasised by many investigators.[1,2,3,4] In the ducks infected with *P. lophuræ*, the degree of anæmia is proportional to the number of parasites in the peripheral blood. A marked drop in the total number of r.b.c. occurs as the peak of parasitæmia is approached; the level of hæmoglobin and the total red cell count returning to normal in the course of 3-5 days after the peak of infection. Death usually occurs on the 10-12 day if not treated. Hill[5] has concluded from her studies on pigeons infected with *P. relictum* that death results from anæmia. Hewitt[4,6] has shown in his study of the morphology of r.b.c. of malaria-infected ducks that varying degree of polychromasia occurs. The nuclei are larger than those of the mature cells and these cells may be round or elliptical. Binucleated and anucleated forms and deeply basophilic erythroblasts may also be found in severe infections. Owing to the similarity of the course of malaria infection in chicks, the present investigation was undertaken with a view to study the hæmatology of chicks infected with *P. gallinaceum*.

Chicks, 8-12 weeks old, were used for the purpose. The strain of the malaria parasite was originally obtained from the King's Institute, Guindy, and was passed by blood inoculation through chicks of different ages and breed, before being transferred to the present series under experiment.

Intramuscular inoculations have been used exclusively throughout the present work. Donor blood was drawn by venipuncture through a hypodermic needle and citrated saline (2·0 per cent. sodium citrate, 0·9 per cent. saline) in amounts equal to the quantity of blood drawn has been used as diluent.

Blood smears were stained with Geimsa and Leishmann stain and parasite counts have been expressed for 500 red cells. This represents the actual number of red cells counted on each slide. Hæmoglobin determinations were made by Sahli's hæmoglobinometer. The total r.b.c. count was done by the usual standard method. Smears were also taken of the bone marrow from the femur, and of the liver, spleen from the infected as well as control birds.

It was observed that the degree of parasitæmia and the severity of anæmia varied with the age of the bird and the size of the inoculum. The course of a typical infection which ended in death is shown in Fig. 1. The

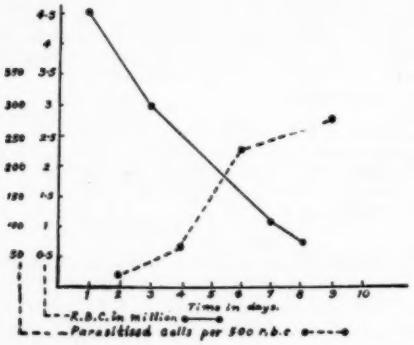

FIG. 1

degree of anæmia is found to be proportional to the parasitæmia. In the case of chicks the peak of parasitæmia was reached on the sixth or seventh day and then the number of parasites in peripheral blood rapidly decreased until only a few were present on the ninth day. In those that survived, the hæmoglobin and red cell count steadly increased from the tenth day onwards. The level of hæmoglobin and colour index run parallel with the total number of erythrocytes in the peripheral blood (Fig. 2).

All the infected birds showed a marked increase in the percentage of young red cells of erythroblastic type. Near the time of death immature forms of erythrocytes enter the peripheral circulation. There was a marked hæmopoetic response of the bone marrow, liver and spleen but the greatest proliferation was found in the bone marrow. With the progress of the anæmia there was an increase in the number of erythroblasts in the peripheral

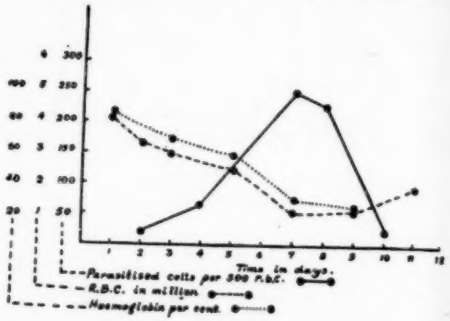

FIG. 2

blood, but variations in the size and shape were noticed during the course of infection. These immature red cells were at first elliptical in shape and slightly smaller than the adult erythrocytes, but as the anæmia progressed and great strain was placed on the bone marrow, the peripheral circulation was flooded with even younger cells; many of these being very small and almost spherical in shape.

The results of our observation were similar to those reported by Hewitt[4], and Rigdon and Rostorfor.[7] It is interesting to note that the young types of erythroblasts in the peripheral blood did not have any parasites in their cytoplasm. The reduction in the number of parasites in the peripheral blood following the peak of parasitæmia might be directly related to the characteristics of this type of anæmia; the parasites apparently prefer the young erythrocytes, to the young erythroblasts.

Our thanks are due to Dr. K. P. Menon for his keen interest and kind encouragement during the course of this work.

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June 28, 1948. A. S. RAMASWAMY.

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STUDIES IN ANTIMALARIALS: SOME R- AND R'- DISUBSTITUTED GUANIDINES

THE discovery, that p-tolyl-guanidine nitrate has a very slight retarding action on a sporozoite-induced infection of *P. gallinaceum* in chicks[1], prompted investigations on the synthesis of a large number of mono- and disubstituted guanidines with a view to studying

TABLE I

No.	Substituted guanidines RNH–C(: NH)–NHR′		Salt	m.p. ° C.
	R	R′		
1[4]	p-Cl–C_6H_4–,	H	HNO_3	141–42
2	p-Cl–C_6H_4–,	–$CH(CH_3)_2$	CH_3COOH	175–76
3	p-Cl–C_6H_4–,	p-Cl–C_6H_4–,	HCl	172
4	p-Cl–C_6H_4–,	p-CH_3O–C_6H_4–,	CH_3COOH	156–57
5	p-Cl–C_6H_4–,	2′-4′(C_2H_5)$_2$$C_6H_3$–,	CH_3COOH	155
6	8-Cl–5–C_9H_5N–,	p-Cl–C_6H_4–,	CH_3COOH	175–76
7	8-Cl–5–C_9H_5N–,	–$CH(CH_3)_2$	CH_3COOH	180
8	p-CH_3–C_6H_4–,	–$CH(CH_3)_2$	CH_3COOH	181–82
9	p-CH_3O–C_6H_4–,	–$CH(CH_3)_2$	HI	125
10	p-NO_2–C_6H_4–,	–$CH(CH_3)_2$	CH_3COOH	159–60
11	2 : 4-Cl_2–C_6H_3–,	–$CH(CH_3)_2$	CH_3COOH	156–57

their activity on malarial infection. King and Tonkin[1] found that out of the compounds they had prepared, *p*-anisyl-guanidine nitrate had the maximum activity. Andrews *et al.*[2,3] postulated that such types of compounds, which were of comparatively small molecular structure, might be capable of penetrating the blood-cells of a sporozoite-induced infection of *P. gallinaceum* in chicks, and have their effect upon the tissue-phase development before the blood became infected.

A number of aromatic and aliphatic substituted guanidines [Table I] have now been synthesized to study the effects of different nuclei, with different substituents therein, on malarial infections.

The compounds were prepared by condensing the amine hydrochloride with the appropriate cyanamides in alcoholic solutions, by refluxing for 6-10 hours. After the reaction was over, the base was liberated from the reaction mixture, by treating it with dilute alkali solution, and was purified by crystallising from organic solvents. The compounds were characterised as acetates or hydrochlorides.

Various unsuccessful attempts were made to condense 2-chloro-7-methoxy-9-amino-acridine hydrochloride and 6-methoxy-2-amino-benzothiazole hydrochloride with isopropyl-cyanamide.

Full details will be published elsewhere.

Thanks are due to Dr. B. H. Iyer for his kind interest in the work, and to the Lady Tata Memorial Trust for the award of a research scholarship to one of us (P. R. Gupta).

Organic Chemistry Laboratories, Indian Institute of Science, Bangalore, *July* 15, 1948.

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THE NITRATION OF 2-NITRO-ACET-PARA-TOLUIDIDE

SCOTT AND ROBINSON[1] who used potassium nitrate and concentrated sulphuric acid, obtained the 2 : 5-dinitro isomer as the chief product of the nitration of 2-nitro-acet-*p*-toluidide. They also made the observation that when nitric acid alone was employed for this purpose it was the 2 : 3-dinitro-acet-*p*-toluidide which predominated. Later, Page and Heasman[2] reported the formation of both these isomerides, using nitric acid alone, and they outlined a method of separation of these which involved deacetylation and crystallisation of the resulting bases from benzene and alcohol.

As it was necessary to prepare the pure 2 : 5-dinitro-*p*-toluidine, in quantity, for the purpose of another investigation in this laboratory, we have now repeated carefully both the procedures, and we are able to say that in so far as the preparation of the 2 : 5-dinitro-*p*-toluidine is concerned, Scott and Robinson's method is definitely superior in that the desired product could be obtained by one crystallisation in a pure condition (M.P. 189° C.) and in tolerably good yields (25% of theory). Attempts made to reproduce the results described by Page and Heasman were unsuccessful: no effective separation of the mixed bases by crystallisation from benzene and alcohol was found possible, although a very small quantity (0·3 gm.) of the 2 : 5-dinitro-base (M.P. 189°C; acetyl derivative M.P. 122° C.) could be isolated by subjecting the mixture to prolonged distillation in steam.

Page and Heasman aver that the first product of nitration by Scott and Robinson's method, crystallised from alcohol, which, according to the latter, melted at 132·5° C.—we found the product to melt over a range of 130-36° C.—could not be the pure 2 : 5-dinitro-acet-*p*-toluidide but only a mixture. This contention has been found to be correct by us. The pure 2:5-dinitro-acet-*p*-toluidide prepared by the acetylation of the corresponding toluidine melts at 122° C., which agrees with the melting point given by Page and Heasman for the product. It is very probable that Scott and Robinson did not reacetylate the liberated pure base, the

melting point of which (189° C.) has been correctly recorded by them, for in that case the discrepancy could not have escaped detection. This seems to be all the more unfortunate in view of the fact that Scott and Robinson did not claim that the 2:5-dinitro derivative was the sole product of nitration with potassium nitrate and sulphuric acid, but only the chief product.

The above mode of nitration, using potassium nitrate and sulphuric acid, has now been extended to that of *m*-chloracetanilide. In this case, 4-nitro-3-chloro acetanilide (M.P. 144°C.) was found to be the main product (yield, 54% of theory), whilst if nitric acid alone was employed, as was previously done by Hodgson and Kershaw,[3] a mixture of 4- and 6-nitro-3-chloracetanilides results, entailing a tedious process of separation.

Investigation on this line is being continued and details will be published elsewhere.

Our thanks are due to the Council of Scientific and Industrial Research, India, for a grant which defrayed the expenses of this investigation and for permission to publish the preliminary results. Our thanks are also due to Professor R. D. Desai of the Department of Chemical Technology, University of Bombay, for the kind gift of 100 gm. of *m*-chloraniline hydrochloride.

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Madras, B. R. Pai.
August 12, 1948.

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VOLVOX IN NORTH INDIA

To the algologist, the occurrence and distribution of the very interesting green alga, *Volvox*, always has a peculiar fascination. The distribution of this genus in India has still to be fully worked out. It has been so far recorded from a small portion of the country only *viz.*, South India and Bombay Presidency, and practically nothing is known regarding its occurrence in the rest of India; which forms the major portion of the country. Iyengar (1933), in his excellent monograph, on the Colonial Volvocales of South India, has given an account of a number of species of *Volvox* occurring in the area. And Apte (1935) has given an account of a few species of *Volvox* from Poona and its neighbourhood in the Bombay Presidency.

The writer collected a *Volvox* from Lucknow in 1929 and sent it to Professor Iyengar, who described it as a new variety, *V. Rousseletii* West var. *lucknowensis* Iyengar (Iyengar, 1933, pp. 350, 351, 370). Last year, the writer collected in October four more species of *Volvox* within the University area at Lucknow from shallow rain-water pools fully exposed to the sun. These four species occurred each separately in pools which were separated from each other by very short distances, only 30 to 40 yards. Three of these species were identified as *V. globator* (L.) Ehrenberg, *V. Carteri* Stein and *V. africanus* West, respectively, while the fourth species could not be identified owing to the absence of the necessary stages.

Of the four species which were collected by the writer in Lucknow, *V. Rousseletii* var. *lucknowensis* is known so far only from Lucknow. *V. Carteri* was first collected by Carter (1859) in Bombay and described by him under the name of *V. globator*, but was later on established as a new species, *V. Carteri*, by Stein (1878) (see Iyengar, 1933, p. 363). *V. Carteri* has since been recorded from Madras by Iyengar (1933) and from Poona by Apte (1936). And *V. globator* and *V. africanus* have been recorded from Bangalore and from Nandi Hills (Mysore Province), respectively, by Iyengar (1933).

Now the fact that four species (five species, if we include the unidentified one) have been collected within a very small area in a single place like Lucknow suggests that the genus is quite likely to be found in several other parts also of North India, if algologists should be on the look out for this genus in these different parts of the country.

The writer in conclusion wishes to express his indebtedness to Professor M. O. P. Iyengar for his kind help in preparing this note.

Department of Botany,
University of Lucknow, A. R. Rao.
May 15, 1947.

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UROMYCES ACORI RAMAKRISHNAN AND RANGASWAMI SP. NOV., ON *ACORUS CALAMUS* L.

Acorus calamus L. grows well in marshy places and on the banks of lakes in Ootacamund and its neighbourhood. In March 1948 it was found to be infected by a rust. The incidence of the rust was more in shaded localities than in open areas. Both uredial and telial stages were observed. These are described below.

Uredia amphigenous, oval, isolated, sometimes gregarious, 1 mm. in length, erumpent, subepidermal, brown in colour; urediospores, pedicellate, subglobose, elliptical or obovate 24×22 μ (22−33×19·5−25·0) yellowish brown to reddish brown, echinulate to verrucose, mixed with clavate, subhyaline or hyaline paraphyses.

Telia closely resemble uredia and found mixed with them on both sides of the leaf; teliospores pedicellate, one-celled, ovate to elliptical, 30×21 μ (27−36×16−25) yellowish brown in

colour, with an apical thickening upto 14 μ and single germ pore at the apex, stalks persitent, up to 41×11 μ, hyaline or subhyaline; paraphyses hyaline or subhyaline, clavate, mixed with teliospores.

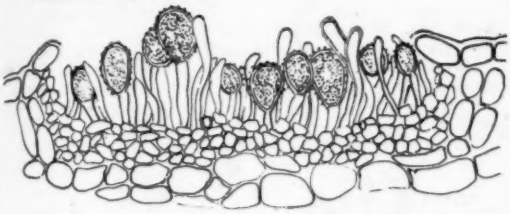

FIG. 1. Section through uredium × 335

On living leaves of *Acorus calamus* L. Ootacamund, 24th March 1948, T. S. Ramakrishnan and G. Rangaswami (type).

Soris uredosporiferis amphigenis, ovalis, isolatis, interdum aggregatis, 1 mm. longis, erumpentis, subepidermis, brunneis; uredosporis pedicellatis, subglobosis, ellipticis vel obovatis, 24×22 μ (22−33×19·5−25·0) echinulatis vel verrucosis, flavo-brunneis vel rubrei-brunneis; paraphysibus numerosis, clavatis, sub-hyalinis vel hyalinis.

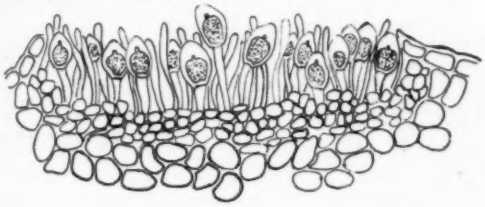

FIG. 2. Section through telium × 140

Soris teleutosporiferis conformibus, urediis immixtis, amphigenis; teleutosporis pedicellatis, unicellatis, ovatis vel ellipticis 30×21 μ (27−36×16−25), flavo-brunneis, apice incrassatis, usque 14 μ, poris germinationis 1, pedicelli persistenti, hyalini vel subhyalini, usque 41×11 μ, paraphysibus clavatis, subhyalinis vel hyalinis.

FIG. 3. Teliospores × 335

In vivis foliis *Acori calami* L. Ootacamund, 24th March 1948, T. S. Ramakrishnan et G. Rangaswami.

Raciborski (Saccardo, 1902) has described *Uredo acori* on *Acorus terrestris* Spreng. from Java. Sydow, H. and P., and Butler (1906) have noticed the same rust on *Acorus calamus* from Gauhati, Assam; and Uppal *et al* (1934) have recorded it on the same host from Poona, Bombay. The rust under study has the uredial stage closely resembling that of *Uredo acori* Rac. already recorded, in spore shape and size though in the description of the fungus by Saccardo no mention is made of the presence of paraphyses. An authentic specimen was kindly supplied by Dr M. K. Patel from Poona and paraphyses were noticed in this. The uredial stage of the rust under study is found to be identical with *U. acori*. The perfect stage of the fungus has now been observed. The telia and uredia are mixed together and occur on the same leaf. Therefore they are considered to belong to the same rust. The telial phase of the fungus shows it to be *Uromyces* and the rust is named as *Uromyces acori*.

Department of Mycology,
Agricultural College and Research Institute, Coimbatore,
June, 23, 1948.

T. S. RAMAKRISHNAN.
G. RANGASWAMI.

1. Saccardo, P. A., *Syll. Fung.*, 1902, **16**, 357. 2. Sydow, H. and P., and Butler, E. J., *Ann. Myc.*, 1906, **4**, 443. 3. Uppal, B. N., Patel, M. K., and Kamat, M. N., *Fungi of Bombay, Dept. Agri. Bombay, Bull.*, **176**, 1934, 16.

PISTILLODY IN SACCHARUM

FROM among the graminaceous plants occurrence of pistillody has been recorded by Anthony[1] and Leighty and Sando[4] in wheat. Isolated instances of pistillody were noticed at this Station by Dutt and Krishnaswami[2] in a few spikelets of the varieties Taboe Woelong and Shamsara as also in a seedling of Glagah × Co. 331, but in the instance recorded below pistillody seems to be a feature or a characteristic of this particular seedling and occurs in all the inflorescences and in all spikelets. The pistil parent of this seedling is *S. spontaneum*, L. (Uganda) which in itself is peculiar among *spontaneums* in that according to Dutt and Krishnaswami[1] it is protogynous.

During the flowering season of 1945-46, an instance of abnormality involving partial or complete transformation of the stamens into processes bearing stigmatic hairs was noticed in a hybrid seedling G. 5023. The malformation was noticed in all the arrows and in each and every spikelet and in all cases all the three stamens were affected, though variation was met with in the degree of transformation of the stamens.

In the upper portion of the arrow, there was complete transformation of the stamens into carpels. The extreme case was wherein all the three stamens were transformed into carpels. In structure these had a membranous ovary-like sac at the bottom with one or two stylar branches having feathery stigmatic hairs (Fig. 3). These bore no resemblance to stamens and could be judged to be transformed stamens only from their positions. In other cases, half of the anther was transformed into carpel while the other half retained its shape, though the contents in the sac were only a pulpy mass. In the transformed portion there

were one or two stylar branches with stigmatic hairs (Fig. 4). In this case a membranous structure slightly swollen and resembling an ovary was noticed in the bottom portion.

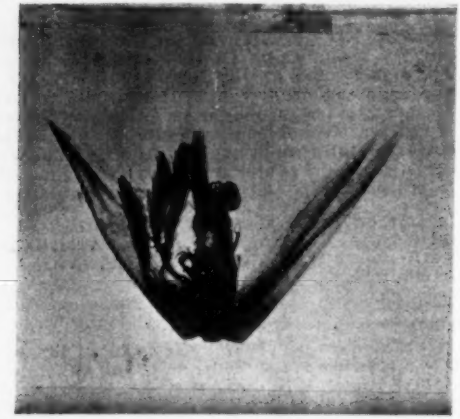

FIG. 1. Shows a spikelet with the glumes opened out and the essential organs *in situ*.

In the lower portion of the arrow, the anthers were normal in size but invariably had feathery stigmatic branches on top (Fig. 5). In others though the dehiscence was normal, the little pollen which was available was unhealthy and did not germinate *in vitro* or *in vivo*. In the middle portion of the arrow all the different degrees of transformation were met with in the same spikelet. This is illustrated in Fig. 2, while Fig. 1 shows the essential organs of the spikelet with the glumes opened out.

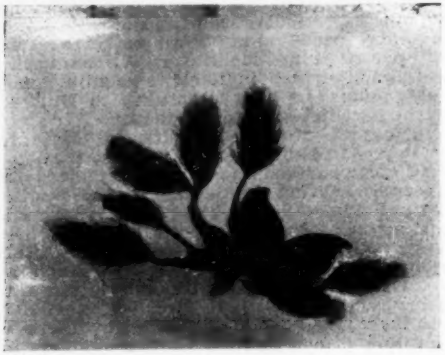

FIG. 2. Shows the different degrees of transformation of the anthers in the same spikelet.

When the arrow was selfed, there was no seed setting indicating that the little pollen available was not capable of fertilising the ovule. Normal seed setting was observed when foreign pollen was used, but it was always the normal carpel which produced the seed.

The above pistillody in G. 5023 was noticed during all the three flowering seasons from 1945-47. This would appear to be due to inherent genic factors and not to influence of environmental conditions.

Another interesting feature noticed in G. 5023 was that like its pistil parent, *S. spontaneum*, L. (Uganda), it is also protogynous. Even the few anthers that dehisce open only two days after the coming out of the stigmas. This coupled with the phenomenon of pistillody enables the variety being used as an ovule parent.

Fig. 3 Fig. 4 Fig. 5

FIG. 3. Shows all the three stamens transformed into carpels. FIG. 4. Shows half the anther transformed. FIG. 5. Shows three normal anthers but with stigmatic branches on top.

A seedling of *S. spontaneum*, L. (Uganda) and *Sorghum rigidifolium* also showed such abnormalities though not to such an extent. Herein the anthers have been partially transformed, there being one or two stylar branches on top of the generally shrivelled anthers which are a pulpy mass containing no pollen grains.

Sugarcane Breed. Station, N. L. DUTT.
Coimbatore, J. THULJARAM RAO.
June 29, 1948.

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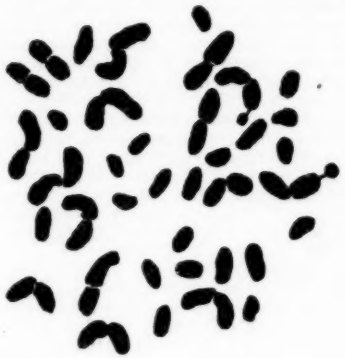
CHROMOSOME NUMBER AND EFFECT OF COLCHICINE ON CHROMOSOMES OF *COLCHICUM LUTEUM*, BAKER

Colchicum luteum, Baker is a Lileaceous plant growing in Afghanistan, Turkistan and Western Himalayas—extending from Murree Hills to Chamba and Kashmir at an altitude of 4,000 feet to 7,000 feet on grasslands. It is an Indian substitute for the European *Colchicum autumnale* as the source of drug Colchicine.

The material was collected from Murree Hills. The corms were grown in December 1946 in pots containing sand which was irrigated regularly with Knops solution. The pots were kept in green-house. Corms produced roots abundantly in about two weeks time.

The root tips fixed were in Craf's fixative. Observations were made from paraffin sections 10 to 12 μ thick which were stained with Crystal Violet-Iodine.

The chromosome number is 38 (Fig.). The chromosomes usually occur in small groups.



Somatic metaphase from a root tip cell showing $2n=38$ × 3,000

Thus it was difficult to count the chromosome number easily. There were obtained, however, some good plates in which the chromosomes could be easily counted.

Some of the chromosomes are dot-shaped and some are comparatively longer. The position of the kinetochore in the long chromosomes appears to be median or nearly so. Two of the chromosomes in the karyotype possess a satellite each with a fine stalk.

The chromosome numbers of other 10 species of the genus as observed by Levan (1940*b*) form an anueploid series of 36,38,40,42,44 and 54. This diversity in the chromosome number coupled with the fact that even in the same species the number varies (Levan, 1940*b*) is interesting. Until detailed studies of mitosis and more particularly meiosis are carried out, it is difficult to throw any light on the basic chromosome number and the nature of polyploidy in the genus.

Incidentally the effect of Colchicine was tried on the root mitoses. The corms with good number of roots were placed in the Colchicine solutions ranging from ·4%–2% for one day to 62 days. During all this time there was no sign of the macroscopic c-tumours so characteristic of the roots treated with Colchicine. The root growth was not at all accelerated or impaired in any way. It was perfectly normal. Longitudinal sections of the treated material fixed at regular intervals, showed that mitoses occur quite normally even when roots were placed in an overdose (2%) of Colchicine for over two months. This observation is in close accord with those of Blakeslee (1939) and Levan (1940*a*) on *Colchicum autumnale*.

This clearly shows that besides *Colchicum autumnale* the spindle of *Colchicum luteum* is also not at all susceptible to Colchicine. Experiments may show that this may be true for all the species of the genus. The genus *Colchicum* seems to have developed this immunity towards Colchicine owing to its faculty of producing the drug in its tissues.

Botany Department, P. N. Mehra.
E. P. University, Amritsar. T. N. Khoshoo.
July 18, 1948.

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XANTHOMONAS MALVACEARUM (ERW. F. SMITH) DOWSON ON EXOTIC COTTONS IN INDIA

Several workers in India have mentioned from time to time the occurrence of bacterial leaf-spot of cotton, although none has so far isolated the pathogen in a pure state. In fact, confusion has existed between this disease, *Alternaria* leaf-spot and anthracnose of cotton.

This disease, also known as angular leaf-spot or black-arm, is quite common on exotic cottons grown at Broach, Dharwar, Gadag, Jalgaon, Surat and Viramgam. Outside this Province, it has been reported from Bellary, Coimbatore and Salem in the Madras Province, Parbhani in Hyderabad State and in the Punjab. The pathogen has now been isolated in pure state for the first time from diseased leaves of exotic cottons received from several places in Bombay Province.

The disease closely resembles the one described by E. F. Smith (1901),[1] which is characterised by minute water-soaked spots measuring 1 to 2 mm. on the lower side of young leaves. These spots look translucent when held against light. During monsoon, the disease can be reproduced in the glasshouses at Poona, 4 days after inoculation. In addition to the lamina of the leaf, the mid-vein, lateral veins and the edges are also infected. The water-soaked spots become brown with purplish margins and ultimately turn black. Gummy bacterial exudations are often found in the form of a crust or scales on the undersurface of the leaves. In severe cases of infection, when several lesions coalesce and veins are attacked, the leaf looks typically wrinkled. Such leaves turn yellow and fall to the ground.

On punctured stems and petioles, the pathogen produces elongated, grayish to sooty black areas after an incubation period of 7 days. Heavily attacked stems show deep cracking and gummosis and can easily be broken by wind, while the infected petioles droop. This stage of the disease is known as 'black-arm'.

Infection of bracts is more visible in the case of 'Sakel' cotton (*G. barbadense*). Young succulent bolls, 13 days after inoculation, show round, raised spots, which become irregular in shape, brown in colour and depressed in the centre. Bacterial ooze in the form of small shining beads is found in the centre of depressed spots, which later turn deep black. Badly affected bolls remain small and shrunken and

drop down prematurely. Mature bolls, when attacked, do not open properly, while lint from such bolls is usually stained yellow. The description of *X. malvacearum* (Erw. F. Smith) Dowson as determined by us is given below:—

Short rods with rounded ends, single or in pairs, rarely in chains, motile by a polar flagellum, gram-negative, not acid fast, capsulated, no spores, strict aerobe.

On potato dextrose agar, the colonies are round, smooth, glistening, butyrous, baryta yellow (Ridgway), convex, no distinctive odour, striations starting from midway coming upto the periphery, 2 cm. in diameter in 7 days. Starch attacked; hydrogen sulphide produced; litmus reduced; nitrates not reduced; produces acid but no gas from dextrose and galactose, but not from mannitol, lactose, raffinose and xylose. It makes no growth in Cohn's and Uschinsky's solutions; M.R.V.P. tests negative; Loeffler's blood serum not liquefied in 10 days; indol and ammonia not produced; optimum pH for growth 6·9 to 7·1; optimum temperature for growth 31-32° C.; sodium chloride tolerant upto 2 per cent.; the thermal death point approximately 50° C.

Exotic cottons belonging to *Gossypium barbadense, G. purpurascens, G. hirsutum,* and *G. thurberi* groups are susceptible in the descending order while some Indian cottons belonging to *G. herbaceum* and *G. arboreum* groups are highly resistant. The organism failed to infect other Malvaceous plants. Further studies on the longevity of the pathogen in the soil and on the seeds, detailed physiology, reactions of Indian cottons, interspecific hybrids and possible methods of control are in progress.

The authors are extremely thankful to Dr. B. N. Uppal, Director of Agriculture, B. P., Poona, for helpful suggestions made during the course of this investigation.

Plant Pathological Laboratory, College of Agriculture, Poona, *July* 2, 1948.

M. K. PATEL.
Y. S. KULKARNI.

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YELLOW MOSAIC OF LETTUCE

LETTUCE plants (*Lactuca sativa* Linn.) grown in the mycological area of this Institute during 1946-47, were found to be affected by yellow mosaic disease. In 1947-48, the disease appeared in a severe form and the percentage of infection varied from 50-80. The first visible symptom in the field is clearing of veins of the youngest leaves associated with pale yellow mosaic mottling. Later, the mosaic symptoms become more pronounced and the lamina gets distorted (Fig. 1). The old infected leaves are much thickened and leathery and have chlorotic areas along the margins. The inflorescence axes borne by diseased plants are not distorted but flowers are few in number. In severely infected plant leaves are not attractive enough to be used for table purpose and the disease thereby reduces their market value.

FIG. 1. Diseased leaves of lettuce affected by yellow mosaic virus.

Under glasshouse conditions in 6-8 days artificially inoculated lettuce plants develop small pale yellowish areas on the youngest leaves along with clearing of the veins. Distortion of the lamina and curvature of the midrib are commonly met with in older leaves. With age mosaic mottle becomes more pronounced and yellow areas on the upper surface of the lamina may be raised with a corresponding depression on the under-surface.

Transmission.—The virus is sap-transmissible. In 1946-47 about 5 per cent. of the plants raised under controlled conditions from seed obtained from the local market were found to be affected by yellow mosaic virus while in 1947-48, the percentage of infection in plants raised from seed of infected plants during the previous season was as high as 30.

Properties of the virus.—The properties of the virus were studied by inoculating young lettuce plants raised under insect-proof conditions with standard extract of the infected plants which had been subjected to different treatments.

The virus remains infective after an exposure for 10 minutes to 86° C., but it loses infectivity when exposed to 87° C. for the same period. The virus retains its infectivity after 60 days storage at room temperature (15°-25° C.) but is rendered innocuous after storage for 64 days. Crude juice of the infected plants when diluted to 1 : 60,000, was found to be infective whereas at 1 : 70,000, it becomes innocuous.

Host range.—The disease is transmissible besides lettuce to. *Nicotiana tabacum* varieties Harrison's special and *White Burley* and *Lycopersicum esculentum* var. Sutton's early market. Mottling and vein-thickening are the prominent symptoms in *N. tabacum* variety Harrison's special while in var. *White Burley* small elliptical pale yellow patches develop which become more pronounced in 25-30 days. Yellow mosaic mottle and thickening of the veins are the chief symptoms in tomato. Blistering, which is commonly seen in severely affected lettuce plants, is not met with in tobacco or tomato. All attempts to infect sweet pea plants with the virus were unsuccessful.

Jagger[1] reported a serious mosaic disease of lettuce from Sanford, Florida, and established its transmission through seed. It, however, differs from the virus studied at Delhi in having a thermal death-point of between 55° and 60° C., a longevity *in vitro* of 24 to 28 hours and extremely low dilution end-point.[2] Moreover, lettuce mosaic virus (*Lactuca* Virus 1)

is readily transmissible to sweet pea *Lathyrus odoratus* in which small brown lesions appear on the main stem.[3] Severin[4] and Linn[5] reported lettuce yellows disease caused by aster (*Callistephus chinensis*) yellows virus which results in yellowing, blanching and curling of the inner leaves; margins of these curled leaves develop small brown spots. Other virus diseases recorded on lettuce by Smith[2] are Dandelion yellow mosaic, cucumber yellow-mottle mosaic, tomato spotted Wilt and 'Big-vein'. Symptoms of all these appear to be different from yellow mosaic disease of lettuce now described.

Division of Mycology and Plant Pathology, Indian Aricultural Research Institute, New Delhi,
July 27, 1948.

R. S. VASUDEVA.
S. P. RAYCHAUDHURI.
P. S. PATHANIAN.

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A NEW BACTERIAL DISEASE OF *IPOMOEA MURICATA*

A NEW bacterial disease of *Ipomœa muricata* growing on the hedges and on the banks of river near Poona had been noticed for the first time in the rainy season of 1947. The disease is characterised by minute spots with bright yellowish areas which enlarge and involve a large part of leaves which become brown and brittle. Infection sometimes follows the veins and when severe, brings about distortion and wilting. Infection occurs through stomata or through vascular system and as such it resembles bean blight or cowpea blight. The pathogene has been isolated in pure state by ordinary plating method. The organism is new to science and hence has been assigned a specific rank.

Xanthomonas Uppalii sp. nov.—Rods with rounded end, $2 \cdot 2 \times 0 \cdot 9 \mu$. Motile with a single polar-flagellum. Gram-negative. Non-capsulated. Not acid fast. No spores. Mostly single. Gelatin liquefied. Fair, smooth, dull, filiform lemon-chrome growth on nutrient agar. Litmus in milk reduced. Nitrites, ammonia and indol not produced. Hydrogen sulphide produced. No growth in Uschinsky's, Cohn's and Koser's uric acid media. Acetyl-methyl-carbinol not produced. Good growth with no acid and no gas in dextrose, lactose, sucrose, mannitol, raffinose, salicin and xylose. Levulose, arabinose not utilised. Starch hydrolysed. Strict aerobe. Optimum temperature 30° C. Thermal death point about 51° C.

Pathogenic on *Ipomœa muricata* but not on *I. batata, Phaseolus vulgaris, Dolichos lablab* and *Vigna catjang*. A detailed paper will shortly be published.

Plant Pathological Laboratory,
College of Agriculture, Poona,
July 22, 1948.

M. K. PATEL.

ROLE OF PROTOZOA IN THE PURIFICATION OF SEWAGE BY "DILUTION"

IN view of our earlier observations on the role of certain forms of protozoa (more especially *Vorticellids*) in the purification of sewage in artificial tanks[1,2] and under certain conditions of land irrigation,[3] it was of interest to study the occurrence and development of such forms in raw sewage before treatment. Examination of some 500 samples of sewage derived from different sources showed (*a*) that they generally contained cysts of the protozoa commonly found in the purification tanks; (*b*) that the sources of the cysts were traceable to washings containing soil, such as sullage and storm water, discharged into the sewers; (*c*) that when the sewage was 'weak', considerable numbers of active protozoa were present; and (*d*) that when the sewage was 'strong' or was diluted with discharges of alkaline or acid wastes in such proportions as to affect appreciably the pH value of the medium (or when the sewage contained certain other trade effluents), no active protozoan was seen.

Continued observations extending over a period of ten years at the Institute sewage works (dealing with domestic sewage) have shown that flow of 'weak' sewage in the sewers facilitated the development of protozoa, such as the species of *Vorticella, Epistylis, Paramœcium* and other smaller ciliates and flagellates, including *Amœba*; that the sewage samples collected at the works were occasionally found to contain nitrite in amounts ranging from traces to about 0·02 parts per 100,000.

Experiments were carried out by diluting raw sewage in varying proportions and keeping these diluted samples in shallow basins (in glass basins of diameter 3¾″ and depth 2¼″, and in porcelain troughs of diameter 8½″ and depth 4½″) and by examining the contents of the basins at frequent intervals for the micro-organisms and the oxidation changes. It was observed that in the 'weak' and diluted samples of sewage large numbers of protozoa developed. The predominant forms of protozoa were *Vorticella* sp. and *Paramœcium* sp., the former generally predominating in the earlier stages (upto about 36 hours); and in the later stages (after about 72 hours) other forms of protozoa, such as *Acineta* sp. and *Stylonychia* sp., also developed. A brownish deposit or sludge was found to be formed more especially in the basins which contained considerable numbers of protozoan cells; when the supernatants in the basins were decanted off and fresh water was added to the settled sludges, increasing amounts of nitrite and nitrate were produced. Thus it is of considerable interest to note in this connection that while the numbers of protozoa that develop in a given volume of sewage depend upon the amount of organic matter and dissolved oxygen

TABLE I

Observations on the protozoal activity in freely exposed samples of 'weak' and diluted sewage
(Results of chemical analyses expressed as parts per 100,000)

Sewage-dilutions	At start	24 hrs. after dilution			48 hrs. after dilution			72 hrs. after dilution		
	Oxygen absorbed from potassium permanganate in 4 hrs.	Oxygen absorption in 4 hrs.	Nitrite nitrogen (N)	No. of active protozoa per c.c. of the mixed liquor (mostly *Vorticella* sp.)	Oxygen absorption in 4 hrs.	Nitrite nitrogen (N)	No. of active protozoa per c.c. (*Vorticella* sp. and *Paramœcium* sp.)	Oxygen absorption in 4 hrs.	Nitrite nitrogen (N)	Protozoa
1 Sewage only ..	4·52	2·80	Nil	4,000	1·76	Nil	600	1·64	Nil	
2 Sewage+water 4 : 1 ..	3·36	2·08	,,	2,500	1·44	,,	300	1·20	,,	Practically no active *Vorticella* sp. but considerable numbers of *Paramœcium* sp. and other forms. The protozoa in basins 5 and 6 were comparatively few.
3 Sewage+water 3 : 2 ..	3·12	1·52	,,	2,000	1·08	,,	200	0·96	Traces	
4 Sewage+water 2 : 3 ..	1·76	0·92	,,	1,500	0·80	,,	100	0·72	0·004	
5 Sewage+water 1 : 4 ..	1·12	0·48	Traces	600	0·48	Traces	40	0·44	0·020	
6 Sewage+water 1 : 9 ..	0·64	0·40	,,	60	0·36	,,	20	0·32	0·004	

Domestic sewage was employed for the above series of experiment. At the start of the experiment there was no active protozoan and there was no nitrite in the medium. The water used for dilution was distilled water stored in glass bottles; the amount of dissolved oxygen in this water was comparable to that in tap water.

The amounts of sludge formed in the different basins were directly proportional to the amounts of sewage matter present at the start; the sludges in all the cases appeared more or less brownish.

in the medium, the progress of nitrification is mainly dependent (within limits) on the amount of available oxygen which should be more than what is actually necessary for the maintenance of the aerobic organisms (Table I).

Similar experiments were carried out by diluting heat-sterilised sewage with distilled water and by introducing cultures of the protozoa and bacteria (as already indicated[1,2]) into the diluted samples; the results showed that the protozoa were much more efficient than the bacteria in bringing about the clarification and oxidation of sewage.

The above observations show the importance of certain ciliate protozoa, such as *Vorticella* sp. and *Paramœcium* sp., and excessive amounts of dissolved oxygen in the purification of sewage by 'dilution'. The evidence on the protozoal activity is of considerable value in explaining the mechanism of the dilution method of sewage disposal on which a large volume of literature has indeed accumulated.[4,5] It may be of particular interest here to refer to the recent note of Fowler[6] embodying some observations which he made long ago, while in Germany in 1913, on the importance of *Vorticella* in determining the extent of purification of sewage when discharged into river.

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Bangalore, V. SUBRAHMANYAN.
July 22, 1948.

1. Pillai, S. C., *Curr. Sci.*, 1941, **10**, 84; *Ibid.*, 1942, **11**, 437. 2. Pillai, S. C., and Subrahmanyan, V., *Nature*, 1942, **150**, 525; *Ibid*, 1944, **154**, 179. 3. Pillai, S. C., Rajagopalan, R., and Seshachar, B. R., *Curr. Sci.*, 1947, **16**, 254. 4. Letts, E. A., and Adeney, W. E., 'Report on the pollution of estuaries and tidal waters', Royal Commission on Sewage Disposal, Fifth Report, 1908, Appendix VI. 5. Adeney, W. E., 'The dilution method of sewage disposal,' Cambridge Public Health Series, 1928, Cambridge University Press. 6. Fowler, G. J., *Science and Culture*, 1947, **12**, 405.

AN APPEAL

THE Zoological Society of Bengal will publish a six-monthly list of papers published by the Zoologists in India, Pakisthan, Burma and Ceylon in each issue of the *Proceedings of the Zoological Society of Bengal* from September 1948 onwards. The Society earnestly seek the co-operation of all the Zoologists of the above dominions in the matter and request them to send copies of reprints of their papers to the Hony. Secretary of the Society at 35, Ballygunge Circular Road, Calcutta 19.

REVIEWS

Principles of Radar. By Denis Taylor and C. H. Westcott. (Published by Cambridge University Press, 1948.) Pp. 141. Price 12 *sh.* 6 *d.* net.

The limitations of sight are great and generally beyond human control. Visual location devices fail under poor visibility condition. Radio waves penetrate fog or haze and darkness; they move with the speed of light and almost in straight lines; they can be produced at high power levels and can be received at low power levels with resonable freedom from interference. So radio waves are employed to locate objects at considerable distance. Hence the name radiolocation or radar.

The book is devoted to an exposition and survey of the principles underlying radar design. Out of ten chapters, the first eight chapters entail an exposition of the principles of primary radar. Principle and use of secondary radar have been discussed in Chapter Ten. The first chapter begins with an explanation of the principle of the method by blocschematic. The second chapter deals briefly with generation and reception of pulse modulated signals. In discussing about receiver noise, no mention has been made about solar noise and cosmic noise. This has been acknowledged by the author in the Preface. The examples on noise are interesting. The third chapter discusses about sender power, receiver sensitivity, nature of reflecting target, the gain and directivity of arrays and propagation condition. The four examples illustrating the method of calculating equivalent noise temperature of the aerial and maximum range of medium aircraft and bomber are very useful. Chapter Four deals with the practical aspects of radio ranging and discusses the accuracy attainable in such method. Chapter Five and Six present in a simple way the principle of plan position indicator (P.P.I.) and beam switching technique for the determination of azimuth and the principle of determination of the elevation of target. Chapter Seven discusses the two-dimensional scanning Detection of target position by reflexion of wireless waves becomes complicated due to the simultaneous arrival of unwanted reflexions from land irregularities, from surface of sea, etc. Chapter Eight discusses the undesirable echoes and the method to minimise them. Design constants of certain radar equipments used during war are mentioned in Chapter Nine The two Appendices giving standard formulæ, and method of calculating equivalent area of scattering, absorbing and echoing need special mention as they are very useful for ready reference to those who are engaged in design of radar.

The authors are to be congratulated for the clear exposition of essential principles of design which makes this book easily understandable. It is hoped that this book will be useful to those physicists and mathematicians who have knowledge of radio and who want to know about primary radar.

S. K. C.

Elements of Strength of Materials. 2nd Edition. By Timoshenko and G. H. Maccullough. (Published by D. Van Nostrand Co., New York, 1948.) Pp. 364. Price $ 4·00.

The subject covered in this volume is fundamental to the student, whether he is going to be a structural engineer designing structures, or a mechanical Engineer designing a machine part. The subject is an expanding one and there are fresh view-points emerging with the continuous research being carried on the various aspects of the subject. For instance, on 'Creep of metals' at high temperatures as well as fatigue of machine parts, our knowledge is still incomplete. So an intelligent appreciation of the fundamental principles is more important to the design student than a mechanical study on the application and use of empirical datas and formulas.

Judged from this view-point, this concise volume on the "Elements of strength of materials" is bound to be received as an up to date text-book on the subject. Prof. Timoshenko is well known for his numerous original contributions. In this volume he has retained the principal features of his classical volumes on "Strength of materials", where he had dealt with the elementary and advanced aspects of the subject in greater detail.

Starting with the determination of the tensile and compressive stresses in elastic members, the student is taken even at an early stage to a conception of combined stresses. Graphical methods for solution of combined stresses, using Mohr's circle is also explained clearly. The subject of rivetted joints, with a brief introduction to welded joints and the usual discussion of such joints in pressure vessels are presented in a way so as to bring out the fundamentals of these topics clearly to the student. He would however have to refer to advanced text-books for more information on the topics.

Both the integration method and area moment method for solving problems on deflection of beams have been given and a brief discussion has been added on the fundamentals of reinforced concrete beam design, without attempting to enumerate all the common formulas used in such design practice. In the treatment columns, instead of the usual empirical treatment, a short analysis from fundamentals has been given, indicating at the same time the place and use of the common empirical formulas.

A chapter on the strain energy theory and its application to statically indeterminate problems is given at the end. There is also a short chapter on mechanical properties of materials and the methods of testing with standard testing machines. The subjects of

creep of metals at elevated temperatures and the fatigue of metals have been discussed in some detail. A brief chapter on photo-elasticity and an Appendix containing a discussion of moments of inertia of sections, with tables of properties of standard sections are additional features in the volume.

On the whole, the author has given in one concise volume (of fourteen chapters), an idea of the fundamentals of the subject drawing the attention of the student at the same time to the limitations in the application of the theories and formulas. A selected number of illustrative problems and a large number of problems for student solution add to the usefulness of this volume as a text-book.

The fact that the second edition, edited with some improvements in 1940, has been already reprinted eighteen times over before 1948, speaks well for the popularity of the book, and I feel sure it will attract wider attention from the Engineering Colleges and Technical Institutes in India.

V. S. JAYARAMAN.

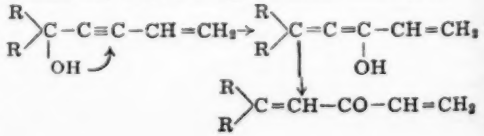
The Chemistry of Acetylene and Related Compounds. By Ernst David Bergmann. (Interscience Publishers, Inc. New York, 1948). Pp. 108. Price $ 3·00.

Coal as a possible raw material for petroleum is a topic of absorbing interest in the present-day petroleum politics and it is therefore to be expected that acetylene, as the most versatile starting material obtainable from coal, should have considerable attention focussed on it. During the last two decades interest in the chemistry of acetylenic compounds has markedly increased and advances in the industrial sphere have brought many fascinating problems to the theoretical organic chemist. Literature on the chemistry and technology of acetylenic compounds, however, is widely scattered and monographs on the subject are few. The book under review which is a reprint of three lectures delivered by the author at the Polytechnic Institute of Brooklyn is, therefore, a timely contribution to the study of the subject. The copious references to literature given throughout the book would also stimulate and help further studies.

In the first lecture the author starts with a consideration of the thermo-chemistry of acetylene and shows how considerations of the free energies of acetylene at higher and lower temperature levels—acetylene forms an exception in that its free energy decreases at higher temperatures—provide the basis for the modern attempts to produce acetylene by high temperature (1200°-1500° C.) cracking of hydrocarbons such as methane or natural gas. As alternatives to the classical carbide process, the two methods extensively studied in recent years—the thermal cracking, and the electric arc process developed chiefly in Germany—both show this feature. The consumption of electric energy is shown not to differ materially from that for the classical carbide process, so that the factor which determines the type of process to be used in any particular instance is more the availability of the material than the cost of the current. The results obtained with the electric treatment appear also to be superior, the yield of acetylene being nearly 45 kilograms from 100 kilograms of the initial gas. The molecular structures from infra-red and Raman spectra and calculations of the length and strength of the C-H bond and its other peculiarities in acetylenes are then described, and on the basis of these, explanations given of the many characteristic reactions of which acetylene and its derivatives are capable. The complete picture which is given of the mechanism of many unusual types of synthesis with CO, ketens, dienes, HCN, diazomethane, sulphur, etc., enabling us to understand their theoretical significance, forms a valuable feature of the first chapter.

The second lecture is devoted mainly to a survey of the reactions that could be carried out with alkali acetylides and their copper analogue as well as those with silver, mercury and copper salts as catalysts. Reppe's researches concerning the addition of formaldehyde using copper acetylide on a carrier under well-defined conditions, and the variety of industrially important compounds whose preparation is thus made possible, are described and a whole table is devoted to compounds obtained by the interaction of acetylene and formaldehyde. The rest of the lecture is devoted to a consideration of Weizmann's extensive work on the addition of acetylene to ketones and aldehydes in a suitable solvent medium containing potassium hydroxide. These condensations make available from acetylene all the monomers which the modern industry of high polymers requires, and a large number of new uses to which they might be put, though of lesser promise, are also indicated. Since acetylene itself gives acetone in as high a yield as 93 per cent. under certain conditions, it provides all the substances required for the production of the known synthetic rubbers. Reppe's vinylation reaction also makes easily accessible many new types of substances from which, by polymerisation with selective agents like boron trifluoride, etc., highly viscous oils, plastics, brittle resins or rubber may be obtained.

The third lecture describes the polymerisation reactions of acetylenic compounds, especially the formation of lower polymers like vinylacetone, divinyl acetylene, cyclo-octatetraene, etc. These reactions are sought to be correlated with the electronic configuration of the acetylenes as revealed by physical measurements. Thus the hydrogenation of the vinylacetylenic carbinols is shown to exhibit the peculiarities of the acetylenic system with all the peculiarities introduced by conjugation. The OH-group can undergo anionotropic rearrangement to divinyl ketones which are extremely prone to polymerisation and yield technically important permanent adhesives:



Equally prone to isomerisation and polymerisation are the tertiary chlorides corresponding to the alcohols, and from the behaviours of those compounds the interesting deduction is made that the triple bond is only a variant of the olefinic double bond. It can participate in a conjugated system with a double bond—i.e., it has electrons which are free and mobile enough to cause resonance phenomena.

The chemistry of acetylenic compounds is still a little known field except to the specialist and interest in the subject deserves to be more widespread. The author has in this little monograph of 104 pages collected all the important material and presented them in a concise and readable form. Very few aspects of importance in acetylene chemistry seem to have been left out although one feels that some more space might have been allotted to the preparative side and to a fuller description of such familiar reactions as hydration, ozonolysis, etc. Another minor criticism which might be made is that the facts presented in the book would have been thrown into better perspective if the material were arranged not in the present form of lectures but in the sequence of historical growth of the subject or of their technical importance.

The book is neatly got up and printed and is remarkably free from errors. The references given at the bottom of every page are fairly exhaustive and the theoretical treatment is lucid and lights up many an obscure point in acetylene chemistry. Much praise is due to the author for writing the book which meets a real need.

B. B. Dey.

The Theory of Valency and the Structure of Chemical Compounds. By P. Rây. (Indian Association for the Cultivation of Science, Calcutta, 1946). Pp. 81.

For some of us who have listened to the Presidental Address of Prof. Rây on the "Doctrine of Valency and the Structure of Chemical Compounds" at the Indian Science Congress Session, 1932, there is little wonder that he should have given such a lucid account of the development of the modern concept of valency and structure of Chemical Compounds. The present work constitutes a summary of the Cooch-Behar Professorship Lectures delivered by the author in 1945 before the Indian Association for the Cultivation of Science. The development of theory of valency has been presented right from the times of Dalton upto the present moment. Although the chemist is very keen in knowing the latest developments in the theory of valency, yet his enthusiasm is often quenched when he sees the treatises on valency full of higher mathematics. It is highly gratifying to note that Prof. Ray has deliberately omitted the mathematical treatment of the subject without, at the same time, sacrificing the fundamental principles involved in the theory.

The first two chapters give a brief historical review of the various stages of the theory of valency including Werner's Theory of Complex Compounds and Thiele's Theory of Partial valency. The third chapter consists of the fundamental principles of electronic theory of valency as developed by Kossel, Lewis, Langmuir, Sidgwick, Rây and Pauling. The electronic structures of atoms and molecules form the subject-matter of the IV Chapter. The principles of quantum theory and their application to the theory of valency have been very well summarised in this chapter with a large number of examples, many of which have been investigated by the author and his co-workers. The V Chapter is devoted to the application of the principles of resonance to the theory of valency. The resonating structures of benzene, carboxyl group, nitrous oxide, boron hydrides and ferrocyanide have been critically examined. The relationship between the absorption of light and the resonance in the molecules, is also given in this chapter. The last chapter deals with the valency in ionic crystals. Two printer's mistakes on pages 16 and 56 have to be rectified in future editons.

Prof. Rây is one of the very few in India who have made substantial contributions to our knowledge in the field of Inorganic Chemistry in general and structure of complex compounds in particular and coming as it does from him, this work is bound to impress the readers, of his wide knowledge and masterly treatment of the subject. The book will be of special interest to all advanced students and research workers in Inorganic and Theoretical Chemistry.

M. R. A.

Chemical and Physical Investigations on Dairy Products. By H. Eilers, R. N. J. Saal and M. Van der Waarden. (Elsevier Publishing Co., Inc., Amsterdam and New York, 1947.) Pp. 215. Price 21 *sh.*

The book contains interesting data on some of the problems of dairy industry re-examined with newer technique. Thus the authors are able to throw new light, on things which are sometimes assumed to have been proved conclusively.

In the first part of the book the composition and structure of the caseinate-phosphate phase in milk and and in heated milk has been studied from different angles. These results have been applied to explain the phenomenon of coagulation of condensed milk. It has long been accepted that the coagulation of condensed milk during the process of sterilization and storage is due to a shift in the salt balance. It has been shown in the present thesis that this coagulation is due to the denaturation accompanied by flocculation of the dispersed phase, with the ultimate formation of spongy aggregates. The dispersion of denatured protein is influenced by several factors like change in pH; increase in the concentration of dispersed phase and of salts, and state of phydration of the proteins. Citrate or phosphate, which are added as stabilizers, prevent coagulation of condensed milk due to their ability to prevent flocculation of denatured proteins. The theory also gives a pausible explanation for the different behaviours of unsweetened and sweetened condensed milk.

The second part of the book describes results of study of oxidation-reduction potential of milk and of butter. The variation in E_h of milk with season was studied and some indication has been given of the relation between E_h and ascorbic acid content of milk. From a study of the E_h of butter, a phypothesis is put forth to explain the likely stages in the progress of deterioration of butter stored at low temperatures. It has also been indicated that raw and pasteurised milk can be protected from the development of oxidised flavour, without the addition of any antioxidants, by adding a small quantity of boiled milk.

Lastly, the authors have studied the process of development of rancidity in butter. It is shown that, contrary to the accepted theory, development of fishy flavour in butter is independent of the presence of trimethylamine. Compounds which cause defects in the taint of cold-storage butter occur in the volatile components condensed at $-196°$ C. The offending flavour substances are shown to be compounds of C, H and O, and are largely of the nature of unsaturated C_4 to C_8 aldehydes. A close correlation was found between the flavour score and peroxide values of butterfat.

The book contains a comprehensive bibliography and though it deals with a highly technical subject like the physical and chemical properties of milk, makes a fascinating reading. It will be a useful supplement to the available standard text-books on the subject. The book has been printed legibly with very few typographical errors.

N. N. D.

Fundamentals of Comparative Embryology of the Vertebrates. By Alfred F. Huettner, (Macmillan, New York, 1948). Price 20*sh.* net. (Pp. xiv + 1-416, 168 text illustrations.)

This is an important contribution to the teaching of Vertebrate Zoology. Originally published in 1941, it is the seventh reprinting of the work that is before us which shows that it has deservedly become popular. Comparative embryology of Vertebrates is always a difficult discipline in the class-room both to the student and the teacher. Many text-books are in the field written by leading authorities in vertebrate morphology but the difficulties of the students in taking a living interest in this essential branch of biology have always remained. Professor Huettner has put in book form the course in elementary comparative embryology which he has been giving for a period of over twenty years and in writing this book his guiding principles have been that, "text-books should be fluently readable, avoid discussions of controversial theories, be well and profusely illustrated and have the illustrations integrated with the text".

The first four chapters are introductory in nature, dealing with the protoplasm and the cell, the development of sex, chromosomes, gametes and fertilization. This section which is well illustrated and takes into account modern developments in biology should prove an excellent introduction not merely to embryology but to any course of lectures in biology, but emphasis is rightly laid on the developmental aspect. The remaining fifteen chapters are devoted to descriptive accounts of the types chosen, *viz.*, Amphioxus, Frog, the chick and the mammal. The descriptions are carefully written and aptly illustrated; the value of the accounts of development lies not in the new information available but in the extremely lucid and workmanlike presentation of the themes in a manner that is stimulating to the serious student. Where contradictory information is available, this is promptly indicated, as for example, on the question of the germ layer that contributes to the formation of the notochord in Amphioxus which most teachers even now assume to be endodermal in origin. In the description of the frog (as also in the other types) it is noteworthy to find attention given to the history of the egg before fertilization which is omitted in most books and, in the account that follows, the author, from his own material, has been able to show that in the various species of frogs obtained by him in America, the neurocœl is never connected with the gastrocœl by a neurenteric canal; similarly there is no neuropore delaying the union of the neural folds in the anterior part of the embryo. These and other corrections have been possible, thanks to the method adopted in the writing of the book. In every case the description and illustrations have been based on the preparations made by the author. The method followed in the illustrations cannot be too highly praised. They have all been done from reconstructions and projections from material prepared by the author paying attention to the value and importance of the three dimensional picture in indicating developmental relationships. All the illustrations are in black and white and are easily reproducible in spite of the 'solidity' and the wealth of details shown. They are refreshingly new and the success of the work is largely due to the high quality of the illustrations.

While this new technique has given much illustrative material in the study of embryology of the frog and Amphioxus, it is natural that in so well described a subject like chick embryology the author has little that is new to offer but, even here, the integration of the text with the original illustrations given is in keeping with the painstaking procedure adopted in the earlier sections. A noteworthy feature in the treatment of mammalian embryology is the selection of human development as the main theme. Descriptive and illustrative material for this have been taken from original papers which are not easily accessible. The value of this part of the book is also enhanced by the very readable account of the modern concepts of hormones and their role in the physiology of reproduction. To those who do not have the time to seek original literature and understand current ideas in this field of work where there is so much that is controversial, a clear statement of the more stable ideas of hormonal regulation of reproduction, as given in this volume, would be particularly welcome.

Certain readers would no doubt deplore the absence of any facts relating to experimental embryology but there is much to be said in favour of the author's attitude to confine the work to the morphological side because, as rightly indicated by him, students of elementary embryology are not well enough prepared to understand experimental data until they have acquired a sound knowledge of the morphological side of development. The absence of references to important original sources (except in the case of borrowed illustrations) which could be pursued by the serious student will also be regretted by many readers. But these cannot be put down as defects in the case of a treatise primarily intended for the classroom where it is sure to become a popular and essential aid for learning vertebrate embryology.

N. K. PANIKKAR.

A Catalogue of Insecticides and Fungicides, Volume I. Chemical Insecticides. Compiled by Donald E. H. Frear, PH.D. Published by Waltham, Mass, U.S.A. The Chronica Botanica Co., Calcutta, Bombay and Madras; Macmillan & Co., Ltd., 1947. Pp. 203. Price $ 6·50.

An attempt has been made by Dr. Frear in this Catalogue to list and classify upto January, 1944, all known chemical compounds (about 10,000), which may possess insecticidal or fungicidal properties. A new classification based on a 'Code number' system has been devised by the compiler. Organic Compounds possessing a similarity of chemical build are listed under the same constituent group. There are sixteen such constituent organic groups, which are arranged in the order of decreasing complexity. The inorganic compounds are divided under the main heads of cations and anions, and the listing under each head is done in an alphabetical order.

Under the referred code number, the name and the empirical formula of the compound is given and side by side its degree of toxicity to particular insects has also been mentioned.

This catalogue is the outcome of painstaking and arduous work and should be regarded as an indispensable reference book for such as are engaged in toxicological or fungicidal work.

This great work of compilation does not include references to many other recently discovered organic chemical compounds. Since the World War II, tremendous advancement has been made in the chemistry and toxicology of organic insecticides and in order to make this Catalogue complete, their inclusion is absolutely necessary in a supplementary list. It is trusted this will be done by the author before long.

A. S. SRIVASTAVA.

SCIENCE NOTES AND NEWS

The Indian Association for the Cultivation of Science (1876-1948).

The report on the working of the Indian Association for the Cultivation of Science is made in three parts.

Part I traces the history of the Association from its inception in 1876 at No. 210, Bowbazaar Street, Calcutta, due to the zeal and endeavour of Dr. Mahendra Lal Sarcar to its present dimensions. The large share played by public munificence and Government patronage is acknowledged.

Part II describes how the activities of the Association of the early days, confined mainly to the dissemination of scientific knowledge through popular lectures changed gradually to the spearhead of research so as to take a momentous turn in 1907 when Sir (then Mr.) C. V. Raman joined it as a member and began his investigations as a regular part-time honorary research worker.

The research activities of the Association between 1907 and 1933 under the dynamic leadership of Professor Raman are described in great detail, with a picture of the first spectrogram obtained by him in 1928 of the now famous Raman Effect. This is followed by an account of the great progress made under Sir (then Mr.) K. S. Krishnan as Mahendra Lal Sarcar Professor between 1934-42.

The section concludes with an account of the research work under Professor K. Banerjee as Mahendra Lal Sarcar Professor between 1943-48.

Part III is in the nature of an appeal to the public for funds, to enable the Association to carry out its schemes of development.

The report is profusely illustrated with photos of the founder, royal patrons and distinguished members and Professors.

Department of Scientific Research

The Government of India have set up with effect from June 1, 1948, a Department of Scientific Research. The Department will work under the Prime Minister. It will take over the Council of Scientific and Industrial Research, the Board of Atomic Research and such other functions of the Director, Scientific and Industrial Research which the Government might decide to transfer to it.

It will also co-ordinate the scientific activities of the other Ministries. In its co-ordination work, the Department will be assisted by a Co-ordination Committee consisting of prominent scientists.

National Metallurgical Laboratory

Dr. George Sachs, Director, Research Laboratory for Mechanical Metallurgy and Professor

of Physical Metallurgy, Case Institute of Technology, Cleveland, Ohio, has been appointed Director, National Metallurgical Laboratory, Jamshedpur. He will assume his new duties on October 1, 1948, although he is now in the part-time service of the Council of Scientific and Industrial Research helping Dr. G. P. Contractor securing equipment and visiting important centres of Research in Europe before his return to India.

The National Metallurgical Laboratory is one of five new governmental research laboratories recently established by the Indian Council for Research and Development, the others being the National Chemical Laboratory, the National Physical Laboratory, a Fuel Research Station, and a Central Glass and Ceramics Research Institutes.

The National Metallurgical Laboratory will cover all aspects of metallurgical research, both fundamental and applied, and will also carry out research work on ores, minerals and refractories. Close co-operation with the modern research laboratory of the nearby Tata Iron and Steel Company will be established. Special consideration will also be given to research on non-ferrous metals such as copper, aluminium, manganese, zinc, titanium and beryllium, of which India has abundant ores, and for the production of which large power resources are available. In the initial stages of the work of the laboratory, the special and urgent needs of India will require particular attention. The N.M.L. therefore includes a well-equipped Technological Section which will permit establishing and operating pilot plants. On long-term research of a fundamental nature, the various National Research Laboratories will work in close co-operation.

It is planned at present to provide 85,200 square feet of laboratories. Ample space is also available for future extension. The main building will have a front of 480 feet. Detailed information may be secured from a pamphlet "Revised Scheme for the Establishment of the National Metallurgical Laboratory, published by the Council of Scientific and Industrial Research, Delhi, 1946.

Atomic Energy Commission

It has just been officially announced that the Government of India has decided to set up an "Atomic Energy Commission" under the distinguished chairmanship of Dr. H. J. Bhabha, Director, Tata Institute of Fundamental Research, Bombay. The commission will be entrusted with the task of surveying the atomic mineral resources of the Dominion and with the responsibility of promoting research in Institutes and Universities. Special steps are expected to be taken to encourage advanced teaching and research in Nuclear Physics in the Universities.

Radio-Cobalt as Cancer Cure

Radio-active cobalt may in a few years replace radium in the treatment of cancer, according to Sir John Cockcroft, Director of Britain's Atomic Energy Research Establishment at Harwell.

Apart from the obvious advantages of cheapness and relatively unlimited availability, radio-cobalt—as it is called—may prove less potentially dangerous than radium when applied to the human body. Its period of intense radio-activity is limited and measurable. But at least another year will pass before there is enough radio-cobalt for anything except research.

When Harwell's new uranium pile, on which preliminary tests began a few weeks ago, is in full operation, it is expected to produce all the radio-active material required in Britain.

Refrigeration of Foods

Over 60 new cold storage plants for the preservation of seed-potatoes and perishable foodstuffs like fruits, vegetables, milk products, eggs, meat and fish and a number of ice manufacturing plants are likely to be installed in India before the next hot season sets in. Located at about 40 different centres in various parts of the country, these plants will have a capacity varying from 3,000 maunds to 30,000 maunds for a single unit, with a total capacity of over a million and a quarter maunds. It will then be possible to preserve enormous quantities of perishable and to spread out their supply over the whole year, if necessary. At present the country has only about a dozen such plants for civilian use.

Popularising Refrigeration

Every year the country suffers heavy losses on account of deterioration in the quality of perishable foodstuffs before marketing or on account of these having to be sold at uneconomical prices in glut markets. "Refrigerated warehouses," as the cold storage plants are known in Western countries, are believed to be the best means known to science for converting these heavy losses into profits. It is estimated that these losses at present in the case, for instance, of seed-potatoes are as high as 50 per cent. Cold storage plants, experts claim, can help to bring down this loss to something like five per cent.

The Central Ministry of Agriculture, which has a special branch called the Refrigeration Development Division, is taking keen interest in popularising the idea of preservation of foodstuffs through refrigeration among the growers with a view ultimately to augment the total availability of foodstuffs in the country all the year round and at the same time protecting the growers from avoidable losses.

International Commission on Large Dams

A Delegation of eight Indian engineers under the leadership of Mr. A. N. Khosla, Chairman, Central Waterpower, Irrigation and Navigation Commission, New Delhi, is shortly leaving for Sweden to participate in the third Plenary Session of the International Commission on Large Dams. Mr. Khosla is also the Vice-President of the International Commission. The delegation will include Rai Bahadur P. C. Aggarwal, Chief Engineer, United Provinces,

Mr. S. R. Krishnamurthi of Madras, Professor M. S. Thacker, Head of the Power Engineering Branch of the Indian Institute of Science, Bangalore, and officers of other administrations. Mr. N. D. Gulhati, Secretary, Central Board of Irrigation, Simla, will be the Secretary to the delegation. This is the first meeting of the International Commission on Large Dams after the last war, and apart from participating in the discussions at the Plenary Session all the delegates to the meeting will be taken round hydro-electric and industrial works in Sweden.

Forest Ranger College at Dehra Dun

The Quinquennial Report of the Indian Forest Ranger College for the period 1941-46 which has just been published reveals that the College has expanded from its initial strength of 34 to one of 113 in 1945-46. It may be of interest to know that the College provides a two-year course in Sylviculture, Forest Management, Protection, Forest Mensuration, Forest Utilization, Forest Law and allied subjects such as, Forest Botany, Forest Pathology, Mycology, Forest Entomology, Geology, Soil Science and Forest Surveying, in addition to intensive practical training and educational tours. Admission is strictly limited to students who have passad out the Intermediate Examination in Science of an Indian University and deputed by Provinces and States with guarantee of employment on the successful completion of the course.

Royal College of Veterinary Surgeons

The Royal College of Veterinary Surgeons, London, has agreed to grant certain concessions to graduates and licentiates of Indian Veterinary Schools who went to take the diploma of M.R.C.V.S. of that College.

Holders of veterinary degrees of the Universities of Agra, Bombay, Madras and Nagpur will be required to take the final examination *plus* one extra subject after a minimum of two years' aitendance at an affiliated veterinary school, but some schools may require a little longer than two years in order to fit in with their courses of instruction. Holders of the diploma of Madras Veterinary College (G.M.V.C.), if in possession of an Inter B.Sc., will be granted exemption from the first professional examination in the diploma of M.R.C.V.S.

The Royal College is also taking steps to have its charters altered in such a way as to enable the graduates of recognised universities to take its post-graduate diplomas which at the moment are reserved exclusively to persons who are members of the College.

When the Veterinary Surgeons Bill, which is now before Parliament, becomes law, there will be increased facilities for post-graduate education at various universities in the United Kingdom, and in addtion two new veterinary schools will be created at Bristol and Cambridge which will help to alleviate the present difficult places at veterinary schools.

Substitute for Linseed Oil

Owing to the continually rising price of linseed oil British chemists have been forced to look for substitutes. Besides such natural alternatives as tung and rubber seed oil, a British firm has been experimenting with mineral-based oils of similar characteristics.

These experiments have now resulted in the discovery that styrene products can be used to replace linseed oil in a wide range of products. A plant is being erected for the manufacture of styrene from coal and when this is in full operation the price of the new oil may be as low as Rs. 304-12 a ton. The latest price for linseed oil from the Argentine is Rs. 2,662 a ton.

Geomagnetic Storms

Some details of the Geomagnetic Storms as recorded at the Alibag Magnetic Observatory are given in the following table in which t_0, t represent the time (I.S.T.) of commencement of the disturbance and its intense phase respectively and T the duration of the intense phase expressed in hours. The ranges in the three different elements (D, H and V) of the earth's magnetic field have also been given, D in minutes of arc, H and V in γ where $1\gamma = 10^{-5}$ gauss. The maximum k-indices (K_M) recorded during the disturbances have also been given.

Date	t_0	t	T	Range			K_M	Nature of commencement
				D	H	V		
	h. m.	h. m.	hrs.	min.	γ	γ		
April 6-7	09 28	22 19	5	4·4	155	54	5	Sudden
April 21-22	04 36	07 06	9	7·7	167	88	5	Sudden (Indistinct)
May 9	12 52	12 52	4½	5·1	185	89	5	Sudden
May 15-17	04 53	04 53	13	7·4	159	84	4	Sudden

Modern Arboretum

Dr. Frans Verdoorn, Managing Editor of *Chronica Botanica* spoke on June 17, before the southern California Botanical Society, at the Rancho Santa Anita, near Pasadena, on "The Modern Arboretum, A Center of Regional, Botanical and Horticultural Synthesis". Dr. F. W. Went, Professer of Biology at the California Institute of Technology, and Chairman of the Trustees of the Los Angeles County Arboretum Foundation, outlined the plans of this foundation which will develop a modern 114 acre arboretum, with educational, horticultural and research departments, at the site of the historical Reid and Baldwin estates at the Rancho Santo Anita.

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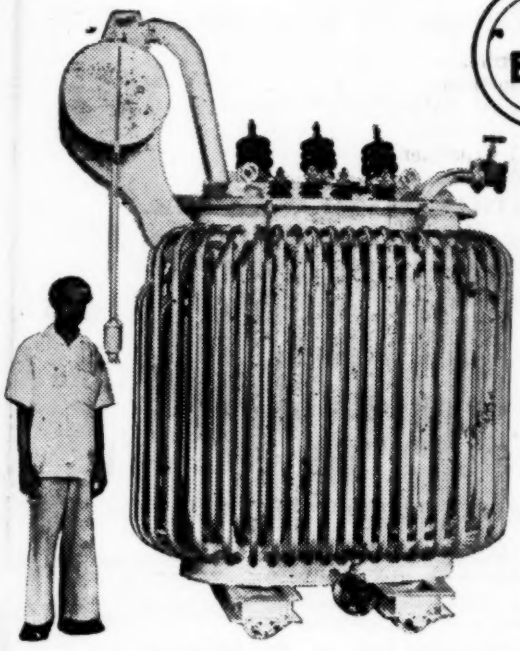

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